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" *To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, MARCH 2, 1916.

THE NEW ZEALAND FLORA.

Illustrations of the New Zealand Flora. Edited by T. F. Cheeseman, assisted by Dr. W. B. Hemsley. Plates drawn by Miss M. Smith. Vol. i., pp. 8+121 plates. Vol. ii., pp. 34+ plates 122–250. (Wellington, N.Z.: John Mackay, Government Printer, 1914.)

PERHAPS no country of equal extent possesses a vegetation more interesting than does New Zealand, the 1600 indigenous vascular plants of which include some three-fourths that are endemic. Few floras have received more attention from a long succession of distinguished workers. The history of botanical discovery in the Dominion from the time of Captain Cook's first visit (1769–70) to the middle of last century is fascinatingly told in Hooker's introductory essay to the second portion of his "Botany of the Antarctic Voyages of the *Erebus* and *Terror,*" retold and continued with more detail half a century later in Cheeseman's "Manual of the New Zealand Flora." Space forbids the recapitulation here of this instructive story; it is, however, worth while recalling the chief attempts that have been made to publish the results achieved. The first of these was an "Essai d'une flore de la Nouvelle Zélande," by A. Richard, issued in 1833 as part of the account of Dumont d'Urville's voyage in the *Astrolabe.* This was followed by Allan Cunningham's less satisfactory "Floræ Novæ Zelandiæ Præcursor," issued in instalments about 1839, and by the fine "Choix de Plantes de la Nouvelle-Zélande," published by Raoul in 1846. Next came the "Flora Novæ-Zelandiæ" of Hooker, which forms part ii. of the results of the voyages of Ross (1839–43), issued under Admiralty authority during 1852–55.

A decade later (1864–67) Hooker published at the request and under the authority of the New Zealand Government his "Handbook of the New Zealand Flora," a work which for thirty years remained the standard authority on the subject and stimulated the activities and the critical acumen of a generation of collectors and students. One of the most active and accomplished of these, the late Mr. T. Kirk, devoted much time to the accumulation of material for a new flora incorporating descriptions of the many novelties discovered and characterised since Hooker's "Handbook" was issued. The services of a competent local botanist being now available, Kirk was asked by the New Zealand Government in 1894 to write a "Students' Flora of New Zealand." Three years later, when less than half his task had been overtaken, Kirk died. The portion of this work actually completed was officially printed, and its quality was such as to increase the regret caused by the author's death and to strengthen the Government resolution to provide the new flora so urgently required.

The preparation of the much-desired work was entrusted to Mr. T. F. Cheeseman, curator of the Auckland Museum. His "Manual," eagerly looked for, when published at Wellington in 1906, received a warm welcome from all who were interested in the vegetation of the Dominion. Except perhaps in England, it was already generally appreciated that botanists are indebted to New Zealand for some of the most weighty additions to natural knowledge in the ecological field. The appearance of Cheeseman's "Manual" taught systematists that the Dominion had besides at least one taxonomic writer in whom are happily blended those powers of observation, that balanced judgment, and that capacity for taking pains so essential in floristic study.

When Cheeseman was commissioned to prepare

his "Manual" the official scheme included the provision of a volume of plates to illustrate some portion of the species described. Two suggestions occurred to those who had urged the undertaking. One was to reproduce on a reduced scale the unpublished engravings prepared to accompany the descriptions by Solander of plants collected during Captain Cook's first visit to New Zealand; the other was to employ afresh the beautiful illustrations which accompany Hooker's "Flora Novæ-Zelandiæ." Both suggestions possess the merit attaching to pious inspirations, though in reality both owed their origin to the hope they held out of enabling the Dominion Government to solve a serious practical difficulty. This difficulty is due to the circumstance that as yet there is not in New Zealand a demand for work of the kind sufficient to induce resident artists to devote themselves to the very special occupation of preparing and reproducing figures of botanical subjects. Fortunately, we think, the demand for the "Flora" itself was so urgent that it was decided to leave the question of illustrations in abeyance until the text should be completed. That question, however, was in the interval carefully considered in all its bearings. For reasons which seem unanswerable, both suggestions were set aside. It was resolved that the "Illustrations" should be new ones, educational in character, expressly drawn for the work, and so designed and executed as to be of use in the study and identification of the plants portrayed. The practical difficulty was frankly recognised, and was overcome by the employment of an artist, a lithographer, and a printer in England, while arrangements were made for the supervision of their work, at every stage, by an English botanist.

The two handsome volumes of "Illustrations of the New Zealand Flora" now before us show how satisfactory these arrangements have been; the artist, whose name appears on the title-page, the lithographer, Mr. J. N. Fitch, and the printers, Messrs. West, Newman, deserve equal commendation for the excellence of their work. In his choice of a supervising colleague, whose name also appears on the title-page, the author of the text has been especially fortunate; Mr. Hemsley has fulfilled his part with remarkable judgment, and, as the author explains, has often been able to make comparisons of the material actually figured so as to confirm its identity with the type of the species concerned. The subjects of the 250 plates have been so selected by Mr. Cheeseman that they illustrate satisfactorily the main features of the New Zealand flora. No really important genus or group of plants is left unrepresented, nor is any latitude or altitude of the Dominion inadequately dealt with. The descriptive matter which accompanies each plate is clear and concise, singularly free from technical terms, and replete with information of botanical, economic, and historical interest. The work is worthy of the reputation of all those concerned in its production, and while it affords proof, were this needed, that New Zealand can command competent botanical assistance, it also shows that the Dominion enjoys an enlightened administration which is fully aware of this fact.

NEW AMERICAN STEAM TABLES.

Properties of Steam and Ammonia. By Prof. G. A. Goodenough. Pp. vii + 108. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s.* 6*d.* net.

THESE tables are a great improvement on previous American work in the matter of thermodynamic method and consistency, but the expressions employed for calculating the tables are too complicated to be of practical use for other purposes, though comparing favourably with many empirical formulæ. The author assumes a characteristic equation of the type,

$$V - b = RT/p - (1 + 3ap^{1/2})m/T^n,$$

and deduces consistent expressions for the total heat and the entropy, according to Callendar's method, by the aid of a formula for the specific heat at zero pressure. He objects to Callendar's equation on the ground that it makes the isothermals straight lines on the pv, p diagram, which is well known to be a good approximation at moderate pressures over the experimental range from 0° to 200° C., but begins to fail at higher pressures. Linde introduced the factor $(1 + ap)$ in the last term to give the desired curvature to the isothermals at high pressures. His equation has been widely adopted in America, but is most unsatisfactory, because it would make steam become a "pluperfect" gas (pv increasing with p at constant t) at a temperature of 400° C., a few degrees above the critical point, which is impossible. The form assumed by Prof. Goodenough escapes this objection, and gives "reasonably good agreement" with throttling experiments, but appears to lead to excessive curvature of the isothermals at low pressures, where they should be very nearly straight, and also gives deficient curvature at high pressures near the critical point, besides making no allowance for the well-known fact that the curvature must change sign at a temperature not far above the critical.

There are many ways in which Callendar's equation may be modified to meet these conditions and give good agreement with the saturation

pressures up to the critical point. But since there are no experimental data for the volume, or the total heat, or the specific heat, or the cooling-effect, at pressures above 8 or 10 atmospheres, it is impossible to decide between different equations satisfactorily at high pressures without further experimental work. It is comparatively easy to calculate values on suitable mathematical assumptions with a fair degree of probability, but it may reasonably be questioned whether it is worth while to risk spoiling the approximation for ordinary purposes for the sake of a doubtful advantage beyond the experimental range.

The expression employed for the variation of the specific heat with temperature gives a minimum in the neighbourhood of 140° C., and the values are nearly constant from 80° to 200° C. The value at 100° C. and atmospheric pressure is nearly the same as that recently found by Brinkworth (*Phil. Trans.*, 1915). The variation with pressure agrees closely with that given by Callendar over the experimental range. The agreement is exact at 70 lb. and 300° F., and also at 200 lb. and 500° F. The increase of S_0 at low temperatures cannot be verified experimentally, and is theoretically improbable. The gradual increase above 200° C. is not improbable in order of magnitude, but the experimental evidence is so conflicting, and the importance of the variation so small for steam engine work, that it may be questioned whether it is worth while to attempt to take account of it. These minor variations, besides being somewhat uncertain, render all the expressions so complicated as to be of little use for practical calculations without reference to tables. The adiabatic equation, in place of being the same as that of a perfect gas, becomes quite unmanageable, and there is no simple relation between the volume and the total heat.

The properties of saturated steam are deduced from an empirical formula for the saturation pressure of the general type,

$$\log p = A + B/T + C \log T + DT + ET^2 + FT^3 + GT^4,$$

which represents very closely the observations on which it is founded. Clapeyron's equation is employed for deducing the latent heat and the heat of the liquid, which serve as a rough verification of the method. The general arrangement of the tables follows familiar lines, but it is to be regretted that they are restricted to British thermal units on the Fahrenheit scale, according to the common practice among American engineers, and that no values are tabulated on the Centigrade scale or expressed in metric units. The only diagram given is that of Mollier, with total heat and entropy as co-ordinates, which is useful for adiabatic expansion, but has the disadvantage of not showing the volume and of having a variable scale of pressure.

The properties of ammonia are developed and tabulated in a similar manner to those of steam, but with less elaboration, owing to the scanty experimental data. The results are noteworthy as the first serious attempt at consistent representation in the case of this vapour. The whole work is admirably lucid, and should do much to advance thermodynamic method in the construction of tables.

OUR BOOKSHELF.

Limes and Cements: Their Nature, Manufacture, and Use. An Elementary Treatise. By E. A. Dancaster. Pp. xii+212. (London: Crosby Lockwood and Son, 1916.) Price 5*s*. net.

THIS is especially suited for students who require an elementary text-book on the subject, containing, as the author justly observes in his preface, very little that will have to be unlearned at a later period. It is sufficiently comprehensive to have some value for many who are not beginners, for though the matter is necessarily compressed in view of the limited space, the ample bibliography of modern publications dealing wholly or partly with the materials under consideration will enable fuller details to be found by such as may need them.

The work is admittedly based on Burnell's "Limes, Cements, Mortars, etc.," but the alterations and additions involved in bringing that treatise up to date render the present volume practically a new production. All the important varieties of lime, artificial and natural cement, mortar, concrete, etc., are noticed, however briefly, including the mode of preparation or occurrence, and the approved manner of using.

A chapter on the chemical analysis of limes and cements gives brief directions for the determination of the principal constituents, and another chapter furnishes descriptions of the physical and mechanical tests applied to some of the substances in question, but chiefly to Portland cement.

It is noteworthy that misprints, though not entirely absent, are commendably rare. Illustrations are not very numerous, but will probably be found sufficient except for special details. The style of the descriptions is clear throughout the book.

J. A. A.

Hancock's Applied Mechanics for Engineers. Revised and rewritten by Prof. N. C. Riggs. Pp. xiii+441. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 10*s*. 6*d*. net.

THE first edition of this book appeared in 1909, and was reviewed in NATURE for September 16 of that year. Considerable alterations have been made in the present edition, and graphical methods have been used more freely. About two hundred new problems have been added to the

previous large number. Statics occupy the first eight chapters, then follow three chapters on motion, two chapters on work and friction, a chapter on the dynamics of rigid bodies, and another on impacts.

The book differs somewhat from most of the text-books on applied mechanics for engineers produced in this country; had it been published in Great Britain it would probably have been called "Applied Mathematics for Engineers." The treatment of the principles of mechanics is exceptionally good, and we can confidently commend the book to any engineering student who wishes to understand more thoroughly many matters which receive but little attention in most of our own text-books. With the omission of some of the more mathematical sections, which could be read profitably by engineering students later in their course, the book would prove very useful to students who desire to attain the standard of the intermediate examinations of the universities. There is a capital section on moments and products of inertia, containing matter for which the engineering student has generally to search in books containing little else of interest to him; the practical examples given in this section are good.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1916. Edited by G. E. Brown. 55th issue. (London: H. Greenwood and Co., Ltd.) Price 1*s*. net.

ALL those who are practically interested in photography look forward to the appearance of the "B. J. Almanac," and in spite of the stress of circumstances they will not be disappointed. Although there are fewer new things to chronicle for last year, the general features of the volume are much as usual. The editor's special contribution is a long article on printing processes. These "practical notes" will be much appreciated. The "Epitome of Progress" section preserves its usual character, but the section usually devoted to a review of the novelties introduced by the trade during the past year is replaced by a survey of the resources of Great Britain and certain well-known firms of Entente nationality in the production of the requisites for photography. This shows that in several important respects we are rendering ourselves independent of German supplies.

An Introductory Course of Practical Magnetism and Electricity. By Dr. J. R. Ashworth. Third Edition. Pp. xvii+96. (London: Whittaker and Co., 1915.) Price 2*s*. net.

THE laboratory course described in this book is divided into thirty sections, and can be worked through in the course of a winter session. The present edition of the book is substantially the same as the previous issues, though some additions have been made. Sections have been introduced on the measurement of the internal resistance of a cell and the effect of joining cells in series and in parallel, and upon the use of the Wheatstone bridge for the comparison of resistances.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Exploration in South-West Africa.

PROF. H. H. W. PEARSON, of Cape Town, has just conducted an exploring expedition through part of the recently conquered "South-West." The expedition, which is expected to yield important economic as well as scientific results, started with the express approval of General Botha, and, like Prof. Pearson's previous journeys through the less explored parts of South Africa, was promoted by the Percy-Sladen Memorial Trust. I have just received the following letter, and I am sure many readers of NATURE will be glad to learn from it that Prof. Pearson has returned safely from his interesting and successful trek.

W. A. HERDMAN.

University of Liverpool, February 18.

CAPE TOWN,
January 28, 1916.

DEAR PROF. HERDMAN,

Just a line to tell you that the journey is accomplished with results which I hope will prove to be quite successful. I learned just what I wanted to learn and a good deal more besides. The route was a particularly interesting one; it showed me more of the transition zone between the littoral desert and the plateau than I had expected, and it gave me a good insight into the relations between the Damaraland and Namaqualand floras. It has connected up the results of my previous journeys, and I can now tackle my general summary much more satisfactorily than I could have done before.

The journey itself was in some respects the most difficult I have ever done. Along the edge of the desert the road disappeared entirely, and we got entangled in the ravines of a peculiarly awkward range of mountains. On December 31 we spent five hours in advancing considerably less than a mile. Both the wagons broke down, one of them twice within half an hour and in a vital part. But for the extraordinary skill of the two Hottentot drivers we should never have got them both through. Darkness found us in a dangerous river-bed, in which, in defiance of all the laws of good trekking, we had to spend the night—and a sleepless one so far as I was concerned. However, the new year was kinder, and although we broke down again in later stages of the journey, I had the satisfaction of taking everything safely into Windhook except two of my thirty donkeys. One of these died on the road; the other I left in a weak condition with one of our military outposts, and it eventually recovered. Our troubles were due primarily to a bad mistake in the *German* maps, and to the fact that for 120 miles the country was absolutely without inhabitants, white or black. . . .

I passed through the semi-independent territory of the Bastard Hottentots. No German dare venture into it, but when these people found I was English they could not do enough for me. The chief sent his son with me for thirty miles to make sure that I regained the trunk road lost through the mistake mentioned above. They and all the natives throughout the country are profoundly thankful that the German *régime* is over—and they have good reason to be.

H. H. W. PEARSON.

Science and the State.

In reference to the recent memorandum signed by thirty-six eminent men of science on the neglect of science in our national organisation, it may be of some interest to your readers to be reminded of the paragraph on a similar topic written by Thomson in his "History of Chemistry," which appeared in 1831, or more than three-quarters of a century ago:—

"What Minister in Great Britain ever attempted to cherish the sciences, or to reward those who cultivate them with success? If we except Mr. Montague, who procured the place of master of the Mint for Sir Isaac Newton, I know of no one. While in every other nation in Europe science is directly promoted, and considerable sums are appropriated for its cultivation and for the support of a certain number of individuals who have shown themselves capable of extending its boundaries, not a single farthing has been devoted to any such purpose in Great Britain. Science has been left entirely to itself; and whatever has been done by way of promoting it has been performed by the unaided exertions of private individuals."

The above statement is not literally true of the present day; but the same spirit of indifference still exists.

J. B. COHEN.

The University, Leeds.

Altitudes of Auroræ.

In NATURE of August 7, 1913 (vol. xci., p. 584), a short account was given of my auroral expedition of 1913. I think, therefore, that the accompanying preliminary result of the determination of altitude (Fig. 1) will interest your readers. More details will soon be published in the *Comptes rendus* of the Paris Academy of Sciences, in the *Astrophysical Journal*, and especially in *Terrestrial Magnetism and Atmospheric Electricity*, where a series of reports are in the press.

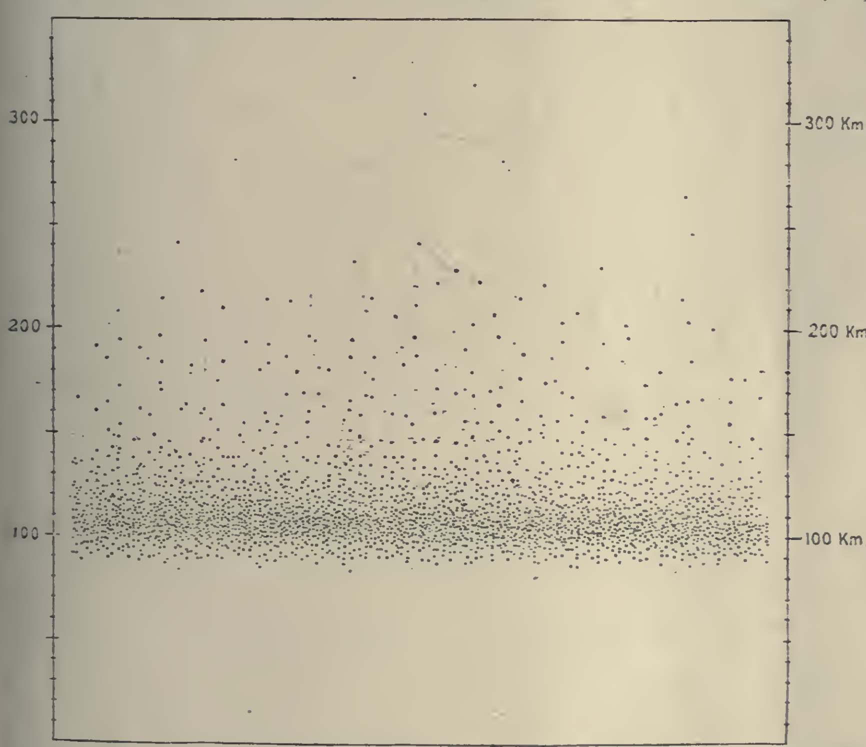
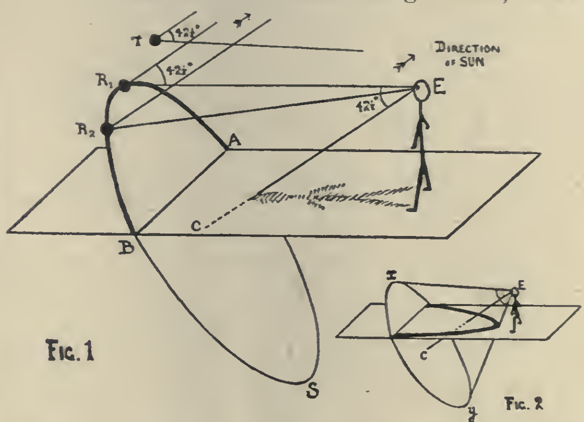


FIG. 1.—The altitude of aurora borealis seen from Bossekop during the spring of 1913. Each calculated altitude is marked by a dot and the several hundred simultaneous photographs of aurora from the stations—Bossekop and Store Korsnes—(mutual distance 27½ kilometres) gave about 2500 determinations of height, which are seen above.

Kristiania, February 15. CARL STÖRMER.

Ground Rainbows.

My observations of ground rainbows are here described in the hope of learning whether the phenomenon is well known. I can find no reference to it, and no information as to how the gossamer, which causes the rainbow, and seems to be a kind of spider-web, comes to be spread over so large an area.



The ground rainbow observed occurred about 11.0 a.m. on October 14, 1915. A cricket field of about two acres was covered with a thick layer of gossamer which the early morning mist had loaded with millions of glittering beads of water. As one walked over the ground a rainbow of about the brilliancy of a good secondary bow moved over the grass—stretching from one's feet in the direction away from the sun in a sweeping curve with two arms. The explanation is obvious on the ordinary theory of primary rainbows.

Those rays will enter the eye which fall on the drops in the direction of the thick circle, AR_1R_2BSA (Fig. 1). But the raindrops were all on the ground, and so what the eye saw was the underneath part, ASB, of the rainbow circle—that is, the rays which lie on the under surface of the cone, Exy (Fig. 2). The rainbow is therefore the trace of the cone, Exy, on the ground plane. It follows at once that the form of this trace will depend on the angle of elevation of the sun; when the sun is in the zenith the curve is a circle, when the angle of elevation is between 90° and 42° it is an ellipse, when 42° a parabola, and when below 42° a hyperbola. Some of my pupils measured the elevation, by finding the height and length of

shadow of an observer, and found it to be 23°. They also pegged out the curve and proved it a hyperbola, and showed that half the angle of the cone was approximately 42°. The gossamer was spread quite evenly over the field, and at the brightest part of the morning—which was still and cloudless—a slight secondary bow could be distinguished.

Mr. N. T. Porter has sent me some photographs of gossamer taken on the lawn of Downing College, Cambridge, one morning some weeks before; when a similar ground rainbow was seen. He adds that he has noticed the gossamer fall in thick clouds on several occasions when out shooting in the early morning.

A. E. HEATH.

Physical Laboratory, Bedales School, Petersfield.

THE APPLICATION OF SCIENTIFIC METHODS TO THE IMPROVEMENT OF THE SUGAR BEET.

An important memoir on the production of improved seeds of the sugar beet is published by M. E. Schribaux in the *Bulletin de la Société d'Encouragement.*[1] The memoir gives one of the best accounts that has yet appeared of the methods of selection which have proved so successful in improving the quality of the sugar beet during the past fifty years. It is to these improvements that the remarkable growth of the beet sugar industry is largely due. They provide an admirable illustration of what can be effected by applying rigorous scientific methods to agricultural practice and industry on the large scale, and demonstrate scientific control pushed to a limit which only a few years back would have been regarded as impracticable or even impossible. This can be best appreciated when it is stated that in selecting the best beet roots to be used as seed-producers, every single root which appears suitable on morphological or other grounds is subjected to chemical analysis. Often more than 3000 roots are analysed each day; for this purpose a staff of three men, assisted by ten women or children, is necessary, and the price of each analysis works out at about four centimes.

The accompanying diagram (Fig. 1) shows at a glance the improvement that has been effected in the quality of the beet since it was first grown as a raw material of the sugar industry. During the interval from 1838 to 1870 seed growers confined their attention almost entirely to physical characteristics, such as form; these efforts were not without success, and led to the adoption of the type which, after its selection by Rabethge and Giesecke, became known as the *Klein Wanzleben,* from the district in Saxony in which it was grown. During this period, too, it was noticed that the largest roots are always the poorest, and a medium-sized root only was therefore aimed at. From 1838 to 1870, the increase in the percentage of sugar was but small, namely, from 8·8 to 10·1 per cent.

The second period of selection opened with the discovery by Louis de Vilmorin of the fact that, although the saccharine quality of the beet is a hereditary character, in order to maintain the improvement of the stock it is necessary to repeat the selection of the seed-bearing plants (*porte-graines*) at frequent intervals. He created the celebrated race *Vilmorin améliorée* associated with his name, by adopting a strictly scientific control in place of the empirical one which had previously determined selection. To ascertain the richness in sugar of the mother plants Vilmorin at first floated the roots in baths of salt or sugar solutions of known specific gravity. This method was soon replaced by a process of ascertaining the density of the juice expressed from small sectors of the roots, and this, in turn, gave way to the polarimetric process which is now universally in use. The methods introduced by Vilmorin were adopted with great success between

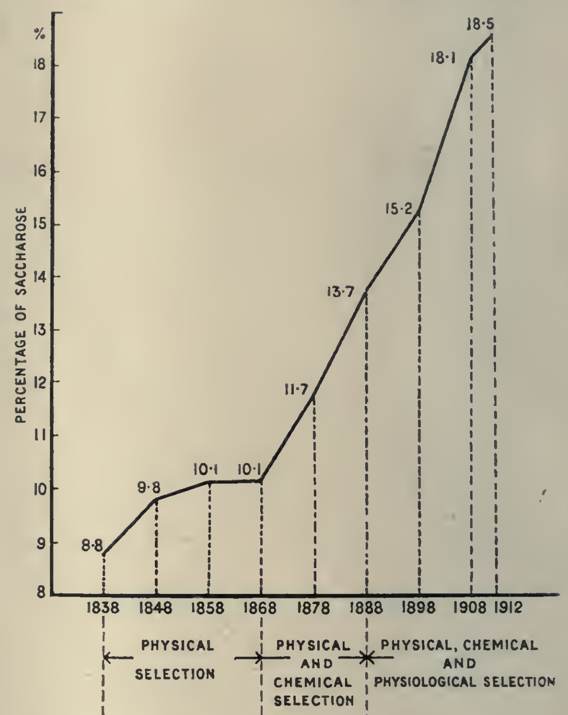


FIG. 1.—Variation of richness in sugar of industrial sugar beets.

1870 and 1890, especially in Germany; during this period of twenty years the sugar content was raised from 10·1 to 13·7 per cent.

Up to this date, however, attention was given only to direct heredity, selection being confined to the mother roots. The next great step in the improvement of the beet was introduced by taking into account the ancestral heredity of the seed-bearers, *pedigree* or *genealogical* selection being adopted. This method was defined by Vilmorin as follows: "It consists in valuing the different reproducing plants separately and individually, keeping the seeds produced by each apart, and determining by direct experiment the faculty of transmission which each plant enjoys." From 1898 to 1912, by this *individual* method of selection, aided and controlled by chemical ana-

[1] "La production des graines de betterave industrielles assurée par l'agriculture française." By E. Schribaux. (*Bull. Soc. d'Encouragement*, vol. cxxiv., No. 4, pp. 178–251)

lysis, the sugar content has been increased from an average of 15·2 to one of 18·5 per cent. Individual roots have contained from 26 to 27 per cent. of sugar, and there is every reason to believe that the improvement of the beet is far from having reached its limit.

It is impossible here to do more than glance at the latest methods of working adopted by the seed-selecter. Each single root grown has its sugar content determined by a process which leaves it practically uninjured and suitable for planting after its character has been ascertained. The small sample of pulp is taken for analysis by means of a small rasp-drill which pierces the root about 2 cm. below the base of the neck at an angle of about 45°. Experience has shown that although the sugar content is very different in different zones, the particular section taken in this way corresponds with the *average* over the whole root. 4·065 grams of the pulp so obtained (one-quarter the "normal" weight) are transferred to a 50 c.c. measuring flask, and water, containing basic lead acetate, added, so as to make the volume about 40–45 c.c. After adjusting exactly to 50 c.c. and filtering, the solution is examined in a 400 mm. continuous-flow saccharimeter tube. In this way the percentage of sugar in the root is read off directly on the instrument.

As a result of the analysis the roots are divided after lifting into three classes: "mothers," "grandmothers," and "élites." Thus, in the case of the 1915 crop, mothers and grandmothers would be used to furnish commercial seed, the "mothers" in 1916, the "grandmothers" in 1918. The "élites" would, in 1916, give seed which, in 1917, would yield the supply of roots to be again subjected to selection.

From time to time the selecter comes across roots the characteristics of which stand out as abnormally desirable. Such plants are subjected to careful genealogical selection in order to ascertain whether their descendants show these qualities on even a greater scale. If so, these roots are made "heads of families" and are the starting-points of new and improved races. Progress in the future largely depends on discovering remarkable "heads of families." For such a result it is necessary, not merely for the operator to be skilled in selection, but he must work on enormous numbers of roots—several hundreds of thousands each year.

A field of future work, which as yet has scarcely been touched, lies in an attempt to avoid the injurious effect of cross-fertilisation, which tends to retrogression of the race. Another rich opportunity for work is to be found in the adaptation of beet seed to local soils and climatic conditions. For this purpose it would be necessary to carry out the experiments with the seed plants in the localities where the main crops are subsequently raised for the sugar manufacturer.

One of the most promising directions for future work in improving the sugar beet is to be found in the asexual method of propagation suggested by Nowoczek and adopted with success by M. Gorain at Offenkerke and M. Hélot at Noyelles-sur-Escaut. In this system multiplication is effected by grafts and buds in the individuals used to give the seed of the first generation of "heads of families" and "élites." Full details are given in M. Schribaux's paper of this system, which has the great advantage of rapidly increasing the number of the specially desirable individuals to be subjected to further selection.

Many other problems face the seed-selecter in France which are dealt with in considerable detail, more particularly that of the improvement of the germinative power of the seed and the best means of rapidly producing in France at the present time the necessary supply of high-grade seeds, which in the past were largely imported from abroad.

W. A. D.

THE RECENT MORTALITY AMONG BEES.

HOME industries and home sources of food supply are to the fore under the present conditions of war. Wastage of native food sources seems to arise from two main factors, namely, ignorance and carelessness. The serious loss of home-produced honey owing to bee diseases, more especially "Isle of Wight" disease and foul brood, is largely to be ascribed to the two human failings just mentioned.

When epidemics of known origin occur in man or vertebrates, such as cattle, there are well-known rules the prompt application of which stops the outbreak. Two prominent preventive measures are destruction of the source of the infection and segregation of the infected individuals and of contacts with them. It is safe to say that had such measures been rigorously enforced when "Isle of Wight" bee disease was first observed in England about 1904, the great mortality recently occurring among bees at Peterborough, as well as in other parts of Great Britain, would not have arisen.

While several diseases are prevalent among bees at the present time, the so-called "Isle of Wight" disease is responsible for much of the damage. The disease is parasitic in character, and a minute, one-celled animal organism, *Nosema apis,* has been shown to be the causal agent. The life-history of the parasite and the mode of infection were elucidated by Drs. Fantham and Porter in 1911, and they have also engaged in researches on the prevention and cure of the malady.

The life cycle of *Nosema apis* may be commenced conveniently with the resistant, infective spore form of the parasite. When some of the contents of the food canal, or the excrement of a bee suffering from the more chronic form of the disease, is examined microscopically, small, rice-grain-like, shining bodies are seen, mingled with pollen grains in various stages of digestion. These small bodies are the spores, which are about one-thousandth the size of an actual rice grain. They have a tough, resistant coat, and, when set free from the body of the bee, can live for a long time. If they are carried by the wind into water at which bees drink, or if they contaminate honey eaten by

bees, the spores pass into the digestive stomach of the bee before undergoing any further change. Under the influence of the digestive fluids of the host, the spore coat or sporocyst softens, and from a pore in it a thin, anchoring thread or polar filament is shot out, which attaches the spore temporarily to the wall of the bee's gut. Once anchored, a minute amœboid germ or amœbula—also termed a planont, because of its power of wandering—emerges from the spore. It creeps about over the surface of the epithelial lining, and finally penetrates in or between cells. There it becomes rounded, loses its power of movement, and grows passively for a time at the expense of the protoplasm of its host. Next, it commences to multiply, and is termed a meront. The nucleus divides into two, and protoplasm collects around each part. The resulting daughter forms separate usually as soon as they are produced, and each repeats the division, a cluster of potential spores, known as sporoblasts, being thus formed. Multiple fission may also occur. Each sporoblast soon secretes a sporocyst and becomes a single spore. During the time that the sporocyst is hardening and becoming opaque, five nuclei are produced within. Two of the nuclei control the formation of the coat, one regulates the action of the polar filament, and the other two are the nuclei of the amœbula. These nuclei are not easily seen all at one time, for when their function is fulfilled, all except the two nuclei of the amœbula disappear.

The most destructive period of the life-history of *Nosema apis* is the meront stage. By the formation of the meront colonies, the digestive cells of the bee are rendered useless and the digestive fluids are not properly secreted. The cells normally are cast off and then burst in order to liberate the digestive fluid. But when they are diseased, food, such as pollen, merely serves as an irritant, and the infected bee succumbs the more easily.

Infection of bees takes place by the ingestion of spores. When a bee is parasitised, its abdomen is often somewhat distended and the slightest touch is sufficient to produce discharge of bowel contents. The result is that honey, comb, and other bees are spattered with excrement that may contain the spores of *Nosema apis*. Cleansing operations are immediately commenced by other bees, which by their very cleanliness may contract the disease that results in their death. The queen, too, may be infected by her attendants, while the larvæ that are fed on infected food may die from the effects of the parasite. Sometimes the larvæ may give rise to a race of young bees, perhaps already infected, but usually with impaired vitality, and thus less capable of resisting infection by way of their food or drink. Water at which bees drink also can be infected with spores.

Other bees may acquire a tolerance for the parasite and be relatively unharmed thereby. Such infected bees act as parasite carriers, and void Nosema spores constantly in their fæces. Showing no external symptoms, they may remain undetected in a hive for some time and ultimately cause great destruction among their fellows. Infected drones also serve to spread the disease by their roving habits, several hives in succession being visited and polluted by them.

Humble bees, wasps, ants, and wax-moths that invade hives can also act as disseminators of spores. Human agency is a further aid. The sending away of unhealthy stocks, union of weak ones, and the use of old comb, foundation and equipment from "dead" hives have all contributed to the spread of disease.

Preventive measures should be vigorously adopted. All hives from which the bees have died out should be closed immediately to prevent robbing and thereby the further dissemination of disease by the robbers. As soon as possible all dead bees, quilts, frames, comb, and foundation in the hives should be burned. If the honey present is extracted from the comb it should be used for cooking purposes only, and not be re-fed to bees. Similarly, if the comb is melted for beeswax the latter should be used for domestic purposes only, and not for making foundation. The interior and exterior of the hive should be scorched or charred over with a painter's lamp in order to destroy the spores of *Nosema apis*. The soil around and under the hives should also be purified by fire. This is easily done by sprinkling petrol or paraffin on the soil and setting light to it. The ground should be well limed. Care should be taken to exclude wasps from hives. These pests were very troublesome in the summer of 1915, and many weakened colonies, some being convalescent, were robbed out and succumbed in the battle with wasps.

Finally, with regard to curative measures, it is known that there are certain drugs that will cure the bees, but their application is inadvisable, since they may poison the honey. Other drugs that are not injurious are known. These are very effective if rightly applied, and if the beekeepers will only help by strict attention to the hygienic and sanitary methods necessary for the prevention of the disease. Without a due regard to such elementary and essential, but often neglected, sanitary procedures, treatment is useless. A further point is that, as with human disease, there is a point when the malady is too far developed to be capable of cure. The disease needs to be treated in its very early stage, when often in the owner's opinion the colony is healthy. Microscopic examination is necessary to detect the parasite, and such examination should be obtained. Treatment based on observations of external symptoms only is not satisfactory, as the range of expression on the part of the bee is very limited, and is apt to be misleading so far as differentiation of disease is concerned. However, prevention is better than cure, and there is little doubt that if concerted action were taken for the quick destruction by fire of all infected materials the losses among bees would be enormously reduced, to the great advantage both of the beekeeper, of the general public, and of the hospitals where honey is much appreciated and used.

F.

ANTHROPOLOGY AND FAUNA OF THE CHAD BASIN.[1]

The volume before us, which is published by the Ministry of the Colonies at Paris, represents—we assume—the outcome of the scientific researches in the very heart of Africa—the basin of Lake Chad—made by the exploring expeditions of the late (?) Commandant Tilho, who between 1906 and 1909 did so much to place correctly on the map of Africa this variable reservoir of the waters streaming northwards from the Congo watershed (it would seem as though this gallant and indefatigable explorer had recently died, from the rather obscure wording of the preface).

Lake Chad was first definitely discovered by the British expedition under Oudney, Denham, and Clapperton, which crossed the Sahara from Tripoli in 1822–23. Its existence had been rumoured in the heart of Africa from Roman times onwards. The twentieth-century investigations of British and French explorers, combined with some previous work done by Germans, indicate Lake Chad and some of the brackish lakes and lakelets to the south-east as the last remains of a vast sheet of shallow water anciently connected with the inner basin of the Niger. Farther back still in earth history, in Cretaceous and probably Eocene times, this huge lake must have stretched from the limits of Senegambia to the Nile and Congo watersheds, and have communicated probably with the Atlantic Ocean to the north of the Senegal River. Even at the present day there is an intermittent water connection between the Chad system and the Upper Benue, and there may well have been a similar connection in earlier times with the south-western basin of the Nile. The altitudes that separate the Congo basin from the Chad and the Benue basins are not considerable, though more marked in height than the line of water-parting at its lowest between the Nile system and that eastern backwater of Lake Chad known as the Bahr-al-Ghazal (this confusing name, which is also applied to the huge south-western area of the Nile basin, simply means "River of Antelopes"). The way in which these great river and lake systems of Central Africa either communicate with one another, or very nearly communicate, reminds one of the water connection between the systems of the Orinoco and the Amazon in analogous Equatorial South America.

The fish fauna collected by Commandant Tilho and his companions comes as an additional proof to the luminous theories of Dr. G. A. Boulenger, of the British Museum, who, by means of his studies of the fresh-water fish of tropical Africa, has shown us that at one period there must have been water communication between the systems of the Senegal, Upper Niger, Benue, Lake Chad, and even the south-western affluents of the Nile. The fish fauna of the Congo basin is far more specialised, and though the two systems of drainage at one time must have been less separated than they are now and have approached one another so near that aerial methods of transporting fish over from one to the other must have been possible, there remains nevertheless a far closer connection between the basins of the Nile, Lake Chad, and the Niger than there is between all these and the Congo and Congolese lakes.

The volume contains chapters on the anthropology of the islands and eastern coastlands of Lake Chad and the western Bahr-al-Ghazal; on the reptiles and the batrachians; on the fish, the gastropods, and the bivalves or fresh-water oysters; on the diptera; and lastly on the botany of the region. The anthropological notes deal chiefly with the Buduma and Kuri of the Chad archipelago, and secondarily with the Kanem-bu and Mangawa, the Teda or Tubu, and the Ulad-sliman Arabs. These last, also known as Wasili, Washila, etc., seem to have migrated to this region from the south of Tripoli some 500 or 600 years ago. The Buduma are an exceedingly interesting people of puzzling characteristics, their language (not illustrated in the work under review) suggesting affinities with the Nilotic group far to the east. Their physique seems to indicate that they are the result of crossing between Nile negroes and the Ful who invaded this Chad region several centuries ago. The physiognomy of the Mangawa, on the other hand, recalls the Bantu type of the northern Congo and south-east Niger basins. The Tubu or Teda are another ethnological puzzle. They speak a negro type of language of no discoverable affinities (virtually identical with the language of Bornu), but in their physical appearance they resemble very strongly the hybrids between Nilotic Negro and Gala of Equatorial East Africa.

Much information is given in regard to the tsetse- and gad-flies of the Chad region.

H. H. Johnston.

[1] "Republique Française. Ministère des Colonies. Documents Scientifiques de la Mission Tilho (1906–09)." Tome troisième. Pp. vii+484. (Paris: E. Larose, 1914.)

PROF. IVAN PETROVITCH PAVLOV.

In the death of Ivan Petrovitch Pavlov, which was announced in the *Times* of February 12, a physiologist has passed away who made the world of medical science his debtor for all time. Pavlov, the son of a secular clergyman, was born in 1849, and thus at his death had not reached the allotted span of human life. When he last mingled with his *confrères* at the International Congress of Physiology in Groningen—little more than two years ago—he appeared to be in the full vigour of life, and no one would have supposed that the summons to his long home would so soon be issued.

Pavlov is chiefly known to the present generation of physiologists by his work on the digestive glands; but this only represents the middle period, though perhaps the chief period, of his activities. His earliest published work (1877) was on the "Accommodation Mechanism of Blood Vessels." This was carried out in the laboratory of Ustimo-

vitsch, in Petrograd, and in it he showed that a reflex constriction of the blood vessels of the ear of the rabbit occurs on opening the abdominal cavity. This was extended in 1879 to reflex effects on blood pressure due to variations in the distension of the stomach before and after section of the vagus nerve. His work, in fact, at this time and for more than fifteen years later was all concerned with innervation mechanisms.

In 1878 he studied the nervous mechanism of pancreatic secretion. This, though vitiated by overlooking certain factors which have since come to light, largely through the investigations of his own pupils, was of a most painstaking character and appeared to bring the secretory mechanism of the gland into line with that of other similar organs. As an outcome of it, he introduced an important improvement in the making of pancreatic fistulæ for the study of the outflow of the juice, the principle of which he extended (1883) to the collection of urine from the urinary bladder.

Up to this time Pavlov remained in Petrograd, but in 1884 he went to Breslau, and there under Heidenhain carried out work—also in the domain of the nervous system—namely, an investigation into the neuro-muscular mechanism of the opening and closure of the valves of the mussel. In 1886 he went to Leipzig to study under Ludwig, and from there published an article on the nervous control of the left ventricle of the heart.

This was followed in 1887 by an elaborate piece of work from Botkin's laboratory, Petrograd, which showed great thoroughness and insight, namely, on the centrifugal nerves of the heart. His conclusions were that there are four classes of such nerves—inhibiting of frequency, inhibiting of force, augmenting of frequency, and augmenting of force of the heart's contractions. This work may be said to mark the close of the first period of his activities. The succeeding fourteen years were devoted to his main life-work—a study of the activities of the digestive glands. In 1888 a further contribution to the secretion and innervation of the pancreas appeared, followed in 1889 and 1890 by articles, in conjunction with Madame Schumova-Simonovskaja, on the innervation of the glands of the stomach. These indubitably established the fact that the secretion of gastric juice is directly controlled by the vagus nerve. The difficulties met and surmounted in this investigation can only be adequately gauged when it is remembered that six years earlier, Heidenhain had written in Hermann's great text-book of physiology as follows:—"The results of the numerous observations quoted proclaim, without doubt, that the extrinsic nerves of the stomach possess no demonstrable influence, of a direct kind, on its secretion" (Hermann, "Handbuch," Bd. v., 1, S. 121, 1883). Numerous colleagues and pupils from this time began to associate themselves with Pavlov, amongst them being M. Nencki, an able biological chemist. To this co-operation is to be attributed work on the ammonia content of the portal and other veins in its relation to the formation of urea by the liver. Pavlov's technical skill was here shown in the success with which he performed the difficult operation of establishing the communication between the portal vein and the inferior vena cava, known as Eck's fistula.

About this time an occurrence took place which greatly influenced the master's later career. In 1885, a short time after Pasteur had discovered his method of treating hydrophobia, an officer of the regiment of the Guards lost his life through the bite of a rabid dog. Prince Alexander Petrovitch, of Oldenburg, who commanded the corps of the Guards at that time, was so affected by the sad event that he established at his own expense a laboratory for the treatment of the disease in the infirmary of the regiment. The work of this laboratory grew; investigations were undertaken, as well as treatment applied, and in 1888 the Prince obtained permission from the Emperor to found an institution for the experimental study of medicine. A site was chosen in the outskirts of Petrograd in a beautiful park adjoining the Neva, and in April, 1891, the Imperial Institute of Experimental Medicine was opened by order of the Czar, with Prince Alexander of Oldenburg as curator. Regular work began in the following October. The institute comprised numerous buildings and laboratories, and embraced six sections, namely, physiology, pathological anatomy, biological chemistry, bacteriology, epizootology, and syphilidology. Pavlov was chosen to be chief of the section of physiology, and Nencki that of biological chemistry.

Here under ideal conditions, with numerous colleagues and a large staff of assistants, Pavlov continued his investigations for the remainder of his life. The earlier work of the institute was published in Russian and French in the *Archives des Science Biologique de St. Pétersbourg,* and a summary of it was given in 1897 by Pavlov in a series of lectures to Russian medical men, which was published in Russian. A German translation appeared in 1898, followed by French and English translations in the next few years. It was mainly through these that European and other physiologists outside Russia, came fully to recognise the importance of the work carried on in Petrograd. It is not too much to say that all were profoundly impressed. Pavlov had for the first time devised methods of obtaining all the important digestive secretions, in pure condition, in exactly measurable quantities, and from animals in perfect health.

In his studies on the secretion of gastric juice Pavlov became impressed with the importance of the psychic stimulus, produced by the taste, sight, and smell of food. This was further shown in the secretion of saliva, where not only the flow, but the composition of the saliva was influenced in this way. Thus *dry* food caused a copious flow of thin, watery saliva; *moist* food a scanty flow of viscid saliva. The former was needed for the chewing of food, the latter only to facilitate swallowing. In these results he recognised the great effect of external, possibly un-

perceived, influences on all the functions of the body. These influences were exercised not alone through visual, but also through auditory and olfactory channels, likewise through cutaneous sensory nerves. Nor was it actually necessary that the food should be presented to produce the psychic effects. A musical note or a bright colour, or a pronounced odour, or a skin stimulus, if associated with the presentation of food, would after a short time become effective alone. Nothing could be more impressive than to see, as the writer has witnessed, a flow of saliva start on the sound of a musical note, except it be the failure to do so on sounding a note not more than a quarter of a tone different from the effective one.

To these phenomena Pavlov gave the name of "conditioned reflexes," and the greater part of his activity from 1901 onwards consisted in making use of them for the objective study of the psychical faculties in higher animals. He claimed that he was thereby restoring to physiology what properly belonged to it, and what had been divorced from it under the name of psychology or psycho-physics. On one point he was very emphatic, namely, that it is only by an active interchange of opinion between the physiologist (using the term in its widest sense) and the physician that the common goal of medical science and medical art can best be reached. In his own work he lived up to this maxim.

Pavlov's fame now drew recognition from many quarters and from various learned societies all over the world. To mention a few of these: in 1904 he was awarded the Nobel prize, in 1907 he was elected a foreign member of the Royal Society, and the same year he was elected an ordinary member of the Imperial Academy of Science, Petrograd. In 1912 he was awarded the honorary degree of D.Sc. by Cambridge University, Cambridge being the only one of the older universities of Great Britain upon the rolls of which Pavlov's name appears. It is true a grace was passed by the Senate of Dublin University to confer upon him the honorary degree of D.Sc., but illness at the time prevented him from attending to have it conferred. In 1913 he was promoted to be director of the Imperial Institute of Experimental Medicine. The last honour bestowed upon him in this country was by the Royal Society in 1915 in the form of the Copley Medal for his investigations in biological science.

Pavlov had a charming personality, and was never happier than in the company of his colleagues and pupils. He was impatient of anything he conceived not to be strictly scientific. In his later years he travelled a good deal, and was present at several of the international congresses of physiology. He visited this country twice, in 1906, when he delivered the Huxley lecture at Charing Cross Hospital, his subject being "The Scientific Investigation of the Psychical Faculties or Processes in Higher Animals," and in 1912, when he came as a delegate to the celebration of the 250th anniversary of the founding of the Royal Society.

W. H. T.

SIR LAURENCE GOMME.

By the death of Sir Laurence Gomme on February 23, at sixty-two years of age, London has lost a most devoted son who loved her with an affection that was not merely filial, but was based upon an exhaustive knowledge of her history and a profound faith in her destiny; more than that, he spent all his life in her service. In early life Sir Laurence Gomme entered first the service of the Fulham District Board of Works, and then that of the Metropolitan Board of Works; when the London County Council was established he joined the Comptroller's Department, then he was made head of the Statistical Department, and in 1900 was appointed Clerk to the Council, which high office he held until last March. He always worked very hard, often up to the very limit of his powers, and about two years ago he had a serious breakdown in health, from which he never fully recovered. Only those conversant with the scope of the London County Council can have any idea of what London owes to him. His annual "Statistical Abstract" of the L.C.C. has served as a model for other municipal bodies. His first book, "Index of Municipal Offices," was published in 1879; it was followed by several others, among which may be mentioned, "The London County Council" (1888), "Lectures on the Principles of Local Government" (1898), "London Statutes" (1907), "The Governance of London" (1907), "London, 1837–1897" (1898), "The Making of London" (1912), "London" (1914).

Ethnology and folklore have lost a keen student in Sir Laurence Gomme, who did more than anyone else to found and direct the early career of the Folklore Society, of which he was first secretary and later president. He was president-elect of Section H (Anthropology) of the meeting of the British Association for the current year. The following list of books will give some idea of his activities in the direction of folklore: "Primitive Folkmoots" (1880), "Folklore Relics of Early Village Life" (1883), "The Village Community" (1890), "Ethnology in Folklore" (1892), "Folklore as an Historical Science" (1904). In addition to a remarkable output of books, he published numerous papers on folklore and allied subjects, all of which are marked by that breadth of view and suggestiveness which was so characteristic of him. He always recognised the great importance of method in ethnological research, and he did his best to raise folklore to a scientific status.

Those who knew Sir Laurence well have lost an inspiring and real friend, a genial personality, and a comrade of wide interests and full of sympathy for various cognate branches of study. He was constantly helping others alike in science and in the everyday walks of life.

Sir Laurence married in 1875 Alice Bertha Merck, author of "The Traditional Games of England, Scotland, and Ireland" (1894–98), who ably assisted her husband in numerous ways, and has been a constant stimulus to him in his work.

A. C. Haddon.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Prof. E. H. Barton, Mr. W. R. Bousfield, Mr. S. G. Brown, Prof. E. G. Coker, Prof. G. G. Henderson, Mr. J. E. Littlewood, Prof. A. McKenzie, Prof. J. A. MacWilliam, Mr. J. H. Maiden, Prof. H. H. W. Pearson, Prof. J. A. Pollock, Sir L. Rogers, Dr. C. Shearer, Prof. D'Arcy W. Thompson, Mr. H. Woods.

SIR RAY LANKESTER writes:—"The serious illness of Prof. Metchnikoff, of the Institut Pasteur, has been briefly noticed by some of the daily papers. Your readers include many friends and admirers of my friend, who will be glad to have accurate information on the subject. It commenced some time before Christmas with distressing symptoms, which were described as 'une crise du cœur.' In order to avoid the daily journey from Sèvres, where he usually resides, and the climbing of the stairs leading to his laboratory, Prof. Metchnikoff, accompanied by Madame Metchnikoff, took up his residence in rooms in the Institut Pasteur which were placed at his disposal, and so he was able to continue his work with the least possible fatigue. But trouble in the lungs now appeared, and developed into an attack of pleurisy and pneumonia, which necessitated his removal to the hospital of the Institut. There he has been for some weeks in a very serious condition. To-day, however (February 26), I hear from Madame Metchnikoff that there is better news. For the third time the pleural cavity has been tapped and a litre of liquid removed, which has given great relief. His medical attendants believe that the pleurisy will now soon disappear. The pulmonary congestion has already disappeared. I will let you know when I hear again from Paris."

MR. DOUGLAS W. FRESHFIELD, president of the Royal Geographical Society, M. Henri Curdier, the French Orientalist, and General Schokalski, the Russian oceanographer, have been elected honorary members of the Italian Royal Geographical Society.

WE learn from *Science* that the Bruce gold medal of the Astronomical Society of the Pacific has been awarded to Dr. G. E. Hale, director of the Mount Wilson Solar Observatory.

THE King's prize of 400*l.* for human physiology has been awarded by the Accademia dei Lincei of Rome to Dr. Filippo Bottazzi, who holds the chair of physiology in the University of Naples.

DR. C. W. HAYES, who was chief geologist to the U.S. Geological Survey from 1902 to 1911, has died at Washington in his fifty-seventh year. He was geologist to the Nicaraguan Canal Commission in 1898–9, and had written largely on theoretical and economic geology.

DR. J. D. FALCONER, lecturer in geography in Glasgow University and Swiney lecturer in geology at the British Museum, has been selected by the Secretary of State for the Colonies for the post of temporary assistant district officer in the northern provinces of Nigeria. Dr. Falconer has been granted leave of absence from the University from the end of the present term.

MR. HAROLD COX will give an address on "Industrial Development," before the Institution of Civil Engineers on March 7. In inviting Mr. Cox to address the institution on this subject, the council has considered that the present time calls for some earnest attention on the part of engineers to the economic issues which, after the war, must influence profoundly the future of engineering, as well as the industrial and commercial enterprises which are vital to its progress both in this country and abroad.

SOME of the bones of the gigantic fossil elephant (*Elephas antiquus*) obtained last summer from Chatham have just been placed on exhibition in the Geological Department of the British Museum (Natural History). With the humerus and scapula have been arranged the corresponding bones of the mammoth from Ilford to show the comparatively small size of the latter. The massive fore foot of the Chatham specimen is especially impressive. The relative smallness of the molar teeth is also noteworthy.

THE death is announced, at Streatham, on February 18, of Prof. R. H. Smith. Accounts of his career appear in *Engineering* and the *Engineer* for February 25. He was born in 1852 in Edinburgh, where he completed his scientific training at the University. His practical training was obtained during an apprenticeship with Messrs. Tennant and Co., of Leith; he had further experience in the Whitworth works, and in the drawing office of Messrs. Wohlers, Berlin. He was appointed professor of civil and mechanical engineering at the Imperial University, Tokio, and afterwards held the professorship in civil, mechanical, and electrical engineering at the Mason College, Birmingham. Prof. Smith contributed many articles on engineering subjects to the technical Press, and was the author of numerous books on commercial economy in steam, heat, and power plants, electric traction, etc.

WE regret to announce the death of Richard Dedekind, which occurred on February 11, at Brunswick, his birthplace (1831) and residence for the greater part of his life. Dedekind is best known by his two arithmetical tracts, "Was sind u. was sollen die Zahlen?" and "Ueber Stetigkeit u. irrationale Zahlen," and by his supplements to successive editions of Dirichlet's "Zahlentheorie." In the latter he developed the theory of ideal primes, invented by Kummer, so as to make it applicable to any field of algebraic numbers whatever. In his two tracts he applies the notion of a *cut* (Schnitt) so as to give an exact definition of an irrational number, and a precise explanation of the continuity of the ordered set of real arithmetical quantities. Each of these achievements is enough to place him in the first rank of pure mathematicians for all time. Not a voluminous writer, his briefest note invariably bears the stamp of his profound and original genius; and, like Dirichlet and Hermite, with whom he may be aptly compared, he wrote with a combination of clearness and elegance difficult to equal, and impossible to surpass.

WE regret to learn, from an obituary notice in the *Victorian Naturalist* for January, of the death of Dr. T. S. Hall, for more than twenty years lecturer in biology in the University of Melbourne, and before that director of the School of Mines at Castlemaine. Dr. Hall's original investigations dealt chiefly with the palæontological aspect of his subject, and he was recognised as a leading authority on the graptolites of Victoria. In 1901 the Geological Society of London awarded him the balance of the proceeds of the Murchison fund in recognition of his researches. He took a very active part in the organisation of scientific work in Australia, and had been president both of the Royal Society of Victoria, and of the Field Naturalists' Club; he also did a great deal of useful work in connection with the Australasian Association for the Advancement of Science. He became personally known to many British men of science on the occasion of the recent visit of the British Association to Australia, when he not only acted as local secretary of the Zoological Section in Melbourne, but rendered valuable services in other directions also. Dr. Hall's charming personality, his sound common sense, and his extraordinarily keen sense of humour endeared him to a large circle of friends, by whom his loss will be very deeply felt. He was fifty-eight years of age at the time of his death.

AT the meeting of the Buteshire Natural History Society, held on February 8, in the society's library at the Bute Museum and Laboratory, the curator, Mr. L. P. W. Renouf, explained at some length the aims and objects of the laboratory and museum under its new *régime*. Briefly, these are to get together a complete collection of the fauna and flora of Bute and its more or less immediate waters, to supplement the actual collection with a card index of occurrences over an extended period so as to have a complete local history of the species, and to provide accommodation for anyone desirous of working at any of the problems of natural history. Emphasis was laid on the exceptional advantages offered by Bute for such an undertaking, its size, position, and industries combining to make it an ideal site for the work. The laboratory offers all the necessary facilities for research work, and possesses equipment for the carrying on of both marine and fresh-water investigations, and the museum already contains the nucleus of a very fine collection. Intending workers should apply to Mr. Renouf, who will be glad to supply any particulars.

THE subordination of science forms the subject of the leading article in *Engineering* for February 25. Our national neglect of science has long been manifest, but there are also some reasons for believing that the fault lies in part with the scientific man himself. British scientific men, including engineers, have formed a habit of rendering the nation gratuitous services of the greatest intrinsic value. There have been many instances of this since the commencement of the war, and, unfortunately, the general attitude towards such services is to value them at cost price. It is probable that the public would take a much higher view of the worth of these services had the scientific experts concerned, like the lawyers, politicians, and certain trade-unionists, made demand for adequate remuneration. There is no doubt also that our unfortunate educational tradition has much to do with the public attitude towards the scientific and engineering expert. There is not a little reason for believing that the country would derive great benefit from an Act making it illegal for any schoolboy under sixteen years of age to devote more than one hour a week to Latin and another hour to Greek. Our public schools in the past have failed to provide a general education, but have been devoted largely to the attempt to convert most of the pupils into classical specialists.

PROF. MOHN has published, through the Fridtjof Nansen Fund, a discussion of the meteorological observations made by the Norwegian Antarctic Expedition of 1911–12, under Capt. Roald Amundsen. The memoir is a pamphlet of seventy-eight pages, and is written in English. The observations at Framheim, the base of the edge of the Barrier near King Edward Land, are discussed in detail, and a full account is given of the less complete observations made on the sledge journey to the south pole and back, including a discussion of the heights deduced from the aneroid and boiling point observations. Great prominence is given to wind, and the relation of the Antarctic winds to other conditions is worked out in a remarkable series of wind roses. The climate of Framheim is dealt with by calculating normals based on the five-years' observations available at McMurdo Sound, taking account of the relation between Amundsen's figures and the synchronous observations of the Scott Expedition. Prof. Mohn states that the climate of Framheim, which was the southernmost meteorological station in the world, may be characterised as having rather low atmospheric pressure, and very low temperature, both lower than at McMurdo Sound (maximum observed, $-0{\cdot}2°$ C. minimum, $-59°$ C.), the yearly mean being $-24°$ C., as compared with $-17{\cdot}4°$ C. for the same latitude in the northern hemisphere. The vapour tension was small, and the relative humidity and cloudiness were moderate; no rain was observed, and snow fell one day out of five. The prevailing wind direction was easterly, and the force moderate, averaging 20 metres per second, being much less than at McMurdo Sound, and gales were very infrequent.

AT the Manchester meeting of the British Association last year it was strongly represented that the association, with its great breadth of interest, might afford an effective mechanism for the investigation of many of the problems of national and Imperial importance which will arise after the close of the war, and already call, or will call later, for scientific investigation and advice. Before the meeting the Section of Economics had made investigation into the questions of outlets for labour after the war, of the effect of the war on credit, currency, and finance, and of industrial harmony. The Engineering Section set on foot at the Manchester meeting an inquiry into problems affecting the national welfare; and at the same time, at the instance of the Chemical Section, a research committee was appointed to inquire into the question of economy in fuel and allied problems. The wider suggestion, as affecting the work of the

sections generally, has been taken up since the meeting by the council, which appointed a committee to deal with the matter, and, on its recommendation, called upon the organising committees of the sections to submit questions, in their various departments of science, which might profitably be investigated. We are informed that a number of important subjects for investigation have already been suggested, and no doubt some of these will find a place in the programme of the next annual meeting, but others are being dealt with in the meantime. There is good reason to hope that this extension of the work of the association will have valuable and far-reaching results.

In *Ancient Egypt*, part i. for 1916, Miss Alice Grenfell publishes a catalogue of the fine collection of scarabs formed by Field-Marshal Lord Grenfell while commanding in Egypt. These are illustrated by a long series of photographs and drawings. It is suggested that the symbols of the double and single spiral signify "life," and that the fish, which originally symbolised Isis and fertility, was utilised by early Christian converts who had no objection to use pagan symbols. Prof. Flinders Petrie adds a note fixing the date of these scarabs. The collection, as a whole, is of the highest value to students of Egyptian religion.

In the January issue of *Man*, Prof. Ashby and his colleagues, MM. Themistocles Zammit and Giuseppe Despott, describe the excavations made in Malta during 1914. The megalithic building, on a site known as Id-debdieba, "the place of the Echo," has been fully examined. The object of this remarkable structure is still uncertain. Among the more remarkable objects unearthed in the course of the excavations are six pillars of limestone or sandstone, cylindrical in shape, but some tapering at one end, of the type usual in Maltese megalithic ruins. Flint implements were rare, but potsherds were abundant, mostly from vessels of Neolithic times, that is to say, contemporary with the original building, and fragments of dark red bricks with a very rough texture, some of which were evidently parts of floors or walls of ovens.

The supplement to the forty-fourth annual report of the Local Government Board, containing the report of the Medical Officer (Dr. Newsholme) for 1914–15, has just been issued. Dr. Newsholme surveys the measures taken on account of the war for co-operation between the civil and military sanitary services, and reviews the incidence of infectious diseases in England and Wales and the development of tuberculosis work over the country. Dr. Bruce Low furnishes a report on the epidemiology of typhus fever in recent years, which deals mainly with the distribution of this disease in the various countries of the globe. Dr. Twort makes a preliminary report on the bacteriology of infantile diarrhœa. Various micro-organisms were isolated by means of a special medium and examined, but so far no evidence has been obtained of the existence of any specific bacterium for this disease. Owing to war conditions, the report is much shorter than usual.

The report just issued by the Medical Research Committee, under the National Health Insurance Act, on "Cerebro-Spinal Fever during the Epidemic of 1915," brings together, in a clear and concise form, a great mass of very careful and well-planned bacteriological work, done by many observers. The authors of the report are Prof. F. W. Andrewes, Prof. Bullock, and Prof. Hewlett; one could scarcely find three names of higher authority. The work done is, of course, scarcely intelligible to those who are not bacteriologists; but the chief conclusions are important to all. That the "meningococcus" is indeed the specific germ of the disease, remains the sure foundation of the work. It is a true species, "as species go amongst bacteria." There are subspecies of it; but these ought none the less to be called meningococcus, not para- or pseudo-meningococcus. From this "specificity" of meningococcus, it follows that bacteriological examination is the necessary method for a positive diagnosis of the case. The whole subject of the detection and treatment of "carriers" is very carefully considered. It appears that even the most vigorous and varied treatments of the back of the throats of carriers may fail to rid them of the germs; the report is more hopeful of good results from "an open-air life and the provision of as much fresh air as possible." For the treatment of the declared disease, the specific antitoxin did not, in the adverse conditions of last winter, fulfil men's expectations: it did not achieve so much as it achieved in the Belfast epidemic of 1907, and in some American epidemics. It remains the only "rational" treatment; but we cannot put it anywhere near diphtheria antitoxin in the records of the art of healing. That is the fault of the disease, not of the bacteriologists.

Miss Maud Haviland, in *British Birds* for February, makes some welcome additions to our records of the life-history of the Lapland bunting. Her notes are based on observations during her stay on the Yenisei. Though she obtained some beautiful photographs of the nest and of nestlings, she failed to obtain pictures of the adults, which refused even to approach the nest while the tent containing the camera was in the neighbourhood. She succeeded, however, in obtaining some valuable notes on the habits of the adults, and the feeding of the young, as well as on the migratory habits of this species. The many peculiarities of this bunting are skilfully brought out by contrasting it with the snow bunting and other species haunting the same area.

Ornithologists, for some inscrutable reason, have paid but little attention hitherto to the many problems presented by the study of the renewal of plumage by moulting. Yet this is a theme of far wider importance than is commonly supposed. Recently, however, our knowledge of this subject has been materially increased by several important papers, and not the least of these is that which appears in the *Scottish Naturalist* for February by Dr. C. B. Ticehurst. His summary of his work, however, is very inadequate, and it is at times difficult to be sure of the precise value he attaches to his observations, which are further marred by the inexcusable use of the term, "tertials," though he is not the only offender in this matter.

THOSE who are inclined to doubt whether museums play any useful part in war-time should read the account of what is being done in the Leicester Museum, by means of an Infant Welfare Exhibition, to combat the appalling mortality among infants. This account appears in the *Museums Journal* for February, and has been written by Mr. E. E. Lowe, the curator, who is responsible for the scheme and its execution. This mortality, which is largely preventable, is brought out with startling vividness by means of a series of wooden columns, that for infants up to twelve months old standing no fewer than 11 ft. high, while that for the death-rate between the ages from five to twenty is but $2\frac{3}{4}$ of an inch high. The food values of human, cow's, and condensed milk, the injurious effects of "dummies," of "push-carts," and of certain kinds of clothing, are brought out by means of specimens, models, or diagrams. Models also are used to demonstrate the dangers of contamination by flies. The keenest interest has been displayed in this exhibition since its installation, especially by the poorer classes, for whom it was more especially intended. Hence it is devoutly to be hoped that this and similar museums will not be closed by the local authorities from mistaken notions of economy in war-time.

A NEW genus of Ranunculaceæ, Beesia, named in honour of the firm of Bees, Ltd.—to whose enterprise so much botanical exploration in China, Burma, and the Himalayas has been accomplished—has been described by Prof. Bayley Balfour and Mr. W. W. Smith in Notes from the Royal Botanic Garden, Edinburgh, vol. ix., No. xli. The new plant, *Beesia cordata,* which is figured, is allied to the Japanese genus Glaucidium, and to the Japanese and American Hydrastis. It was collected by Mr. F. Kingdon Ward in northern Burma, at 9000 ft. altitude, in the deep shade of the rain forest.

THE annual report of the Agricultural Department, St. Vincent, shows that a good deal of useful work has been done in the past year in connection with efforts to raise new strains of cotton, particularly with reference to disease resistance. The progress of the cotton industry is well shown in the tables covering the period of the last ten years. The area planted in 1905–6 was 790 acres, and in 1914–15 4226 acres, though in 1911–12 it rose to more than 5000 acres. The weight of lint in 1905–6 was 137,460 lb., and in 1910–11 reached as high a figure as 561,526 lb., the average yield of lint per acre for the ten years being 128 lb.

WE notice in *La Geographie* for November, 1915, that the hydrographic department of the French Admiralty have replaced the German names in Kerguelen by names of French origin. It must be very galling to the French to see an abundance of German names scattered over the chart of their Antarctic island, especially as German explorers were never sparing in their naming or very mindful of previous names. At the same time, however, the practice of changing established names is a dangerous one if carried far, and it is to be hoped, in the interests of geographical accuracy, this principle will not be applied indiscriminately, for confusion would certainly be the result. The new names for Kerguelen appear in the *Avis aux Navigateurs* of May 29, 1915.

AN article on the Peru-Bolivia boundary commission, by Sir Thomas Holdich, in the *Geographical Journal* for February (vol. xlvii., No. 2) is another reminder, were any required, of the losses that geographical science has sustained by the war. In January, 1911, the services of four British officers were lent to the Government of Peru to determine the boundary with Bolivia. Two of them, Capt. H. S. Toppin, Northumberland Fusiliers, and Lieut. C. G. Moores, R.E., have already lost their lives in action. Capt. Toppin was to have written the report for the Peruvian Government. When that became impossible the Royal Geographical Society was asked to undertake the work, and it was placed by the society in the hands of Sir Thomas Holdich. Moreover, in certain circumstances in the dispute the Royal Geographical Society was made arbitrator by the Peruvian Government. In the same number of the *Geographical Journal* is a paper by the late Capt. Toppin on the diplomatic history of the Peru-Bolivia boundary.

MR. F. E. WRIGHT, writing in the Journal of the Washington Academy of Sciences, vi., 1, describes a device for solving equations of the form $a=bc$, where a, b, c are functions for which suitable scales of representation have been plotted. The method is apparently based on the geometrical construction for the product of two quantities by treating the latter as the fourth term of a proportion having unity as the first. It is, however, not easy to follow from the description, but it may be useful to overcome the difficulties in cases where some process of the kind has to be frequently used.

DICHROIC fog is one of the troubles of the amateur photographer when plates are developed under difficult conditions as to temperature or otherwise. An investigation of its causes, prevention, and cure is given by M. Ernest Coustet in the *Revue générale des Sciences* (xxvi., 21). Of the causes, the most important is the presence of traces of the fixing salt in the developer or of the developer in the fixing salt. The latter appears to be the most important, and thorough washing before fixing the best preventive. A high temperature and a weak fixing bath are favourable to fogging. Of remedies the author recommends neutral (never acid) permanganate followed by bisulphite of soda.

THE issue of the index numbers of the two sections of *Science Abstracts* completes the volumes for the year 1915. The physics volume has 770 pages and the electrical engineering volume 622, while the number of abstracts are 1789 and 1152 respectively. The volumes are therefore quite equal in size to those issued before the war, though there seems to be a small decrease in the number of articles abstracted, partly no doubt due to the reduction in the amount of scientific work being published. The name indexes include names of authors and those mentioned in abstracts, and cover twenty-nine and fifteen pages re-

spectively. The subject indexes extend to fifty-two and thirty pages respectively, and the method of arrangement adopted in past years is continued. The facility with which a piece of research can be looked up in "Science Abstracts" makes it invaluable to those engaged in scientific work in either physics or electrical engineering.

The Journal of the Royal Society of Arts for December 31 contains an interesting article by Sir Charles Watson on the origin of English measures of length. The author is of opinion that the measures of length used by the different nations of the world are for the most part derived from a common origin. He regards the longer measures of distance as having been first used by a people who possessed a high degree of astronomical knowledge, who were acquainted with the form of the earth and were able to carry out accurate geodetic measurements. He explains the means by which the ancients determined the unit for terrestrial measurements of distance, now known as a geographical mile, and he then proceeds to consider how the subdivisions of the geographical mile were assimilated with the cubit. Two new cubits appear to have been invented for this purpose; one of these was equivalent to 18·225 English inches, and the other, afterwards known as the Babylonian royal cubit, was equal to 20·25 inches. Sir Charles points out that the English sea mile is exactly the same as the geographical mile of the Babylonian system; that its tenth part, the cable length, is identical with the stadium; and that generally the English measures of length are no haphazard modern invention, but have come down to us from prehistoric times.

A short article on the production of potash in the United States appears in the *Chemical Trade Journal* of February 12. In 1915 steps were taken to produce potash salts on a commercial scale in the United States, and the plant of the Universal Products Corporation began to operate in October last at Marysvale, Utah, producing both potassium sulphate and alumina in high-grade form. The rated capacity of the works is from 25 to 30 tons of 95 per cent. potassium sulphate per day. The present plant handles about 150 tons of alunite daily, and plans are being made to double its capacity. At Searles Lake, California, the American Trona Corporation proceeded with the construction of its works to treat the potassium-bearing brine of that desert basin by the Grimwood process. At Trona (Searles Lake) only mixed salts are produced from the first part of the process, and these are refined at the port of San Pedro, California. The initial plants are expected to produce 100 tons of potash and 30 tons of borax daily. The alunite deposits of the Florence Mining and Milling Company at Marysvale, Utah, is to be exploited by a newly-formed corporation, the Utah Potash Syndicate. Some plants were erected elsewhere to utilise the potash of the felspars, but did not get into operation on a commercial scale.

"The *Athenaeum* Subject Index" to the periodical literature on the economic, political, and military history of the war is a classified list of the titles of articles that have appeared during 1915. About 150 periodicals are cited, including twenty published in the United States and ten published in France. There is an alphabetical list of authors' names. The titles of the articles are classified under more than 250 headings, arranged in alphabetical order. The primary classification is in great measure topographical, being based upon the names of countries, and such headings as "Eastern Question" and "European War." These main sections are, however, subdivided into subsections, such as "Army," "Colonies," "Commerce," "Economic Condition," "Finance," and "Intellectual Life." In addition to the topographical headings, there are many others, such as "Aliens," "Architecture," "Civilisation," "Compulsory Service," "Eugenics," "Food Supply," "Liquor Problem," "National Characteristics," and "Social Psychology." In drawing up such a list it is obviously very difficult to decide what are the subjects of greatest interest to those who will consult the index. Compensation for any defects in the arrangement will be found in the large number of cross-references, which make it possible without much difficulty to trace the various entries relating to any subject that may not have been confined to one section.

The letter of Sir Lauder Brunton which we published in our issue of February 10 (vol. xcvi., p. 649), advocating the introduction of Latin as an international language, has inspired several communications on the subject for which we are unable to find space. Mr. L. F. Richardson, of Eskdalemuir Observatory, directs attention to the simplicity of "Ido," which has been suggested as an international language, and points out that the language can be read by anyone. Mr. F. H. Perrycoste, Polperro, Cornwall, emphasises the saving of time which would result from the adoption of Sir Lauder Brunton's suggestion, and urges that most people would really be better off with a good equipment of Latin than they now are "with a more or less efficient or inefficient equipment of French and German and a practically useless semi-equipment of Latin acquired at enormous expense of school time." Mr. P. W. Stuart-Menteath, writing from Ciboure, Basses Pyrénées, maintains that "The revival of Latin as the unique language of science can alone secure the co-operation of the humanist, the intellectual independence of the Latin nations, and the essential unity of both their science and their religion." Mr. C. M. Houghton urges the advantages of Esperanto, the inventor of which was an adherent to the Latin project for many years before he constructed his artificial language for international use. He adds that Mr. W. J. Clark's "International Language" (Dent, 1s. net) "contains a *résumé* of the history of the problem and its solution from 1653 up to 1910, together with a large amount of other valuable information."

In future the journal hitherto known as the *Journal of Economic Biology* will bear the name of the *Journal of Zoological Research*, the subject-matter of which will be confined to original zoological research—systematic and anatomical. The style and price of the periodical will remain unaltered.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—The Astronomer Royal informs us that he has received the following telegram from Prof. O. Baeklund, director of the Pulkova Observatory:—"New comet Neujmin., 11·0 mag., February 24, 9h. 17m. Simeis M.T., R.A. 8h. 58m. 40s., declination 16° 24′ N. Motion slow. Probably south." A further observation telephoned to us as we go to press is as follows:—R.A. 8h. 58m. 29·8s., declination +14° 42′ 58″, February 27, 11h. 33·6m., G.M.T.

COMET 1915*a* (MELLISH).—Additional measures of the condensations in the tail of this comet are given in Lowell Observatory Bulletin, No. 70. Photographs taken with the 40-in. reflector have been measured by Mr. C. O. Lampland. Mr. E. C. Slipher made visual micrometric measures with the 24-in. refractor.

The following positions of the comet are extracted from an ephemeris given in Circular 501 of the *Astronomischen Nachrichten*:—

12*h*. *G.M.T.*

	R.A. h. m. s.	Dec. ° ′	Mag.
March 2 ...	3 37 24 ...	+20 56·6 ...	11·7
6 ...	40 12 ...	21 27·2 ...	
10 ...	43 9 ...	21 56·9 ...	11·9

U.S. NAVAL OBSERVATORY, 1915.—We have received a copy of the report of the superintendent of this extremely active institution. The Gaithersburg Station of the International Latitude Service has been discontinued. Dr. F. E. Ross has been transferred to Washington, together with the photographic zenith tube for continuous determination of the variation of latitude.

A DAYLIGHT METEOR.—An extremely interesting account of a great meteor seen over the Chusan Archipelago during the forenoon of February 13, 1915, has been given by Capt. W. F. Tyler, R.N.R., in a paper communicated to the North China Branch of the Royal Asiatic Society (Journal, vol. xlvi.). Capt Tyler's attention was directed to the matter by the report of the light-keeper at Steep Island that a man-of-war had fired an aerial torpedo which nearly hit the tower. The combined observations from a number of adjacent islands and from Shanghai seem to be best fitted by assuming the meteor followed a strongly curved path, at first travelling a little east of north, and finally moving towards the south-east. The meteor was seen to fall into the sea near Video Island, and a violent explosion was heard over a very wide area. It is notable that exceptional meteoric displays have been recorded about this date in previous years.

A TRANSNEPTUNIAN PLANET.—The first number of the first volume of the Memoirs of the Lowell Observatory deals with this alluring subject. Although the cometary evidence which has been held to indicate the existence of an additional member of the solar system may be open to other interpretation, yet it may be confidently predicted that extended knowledge of the motions of the known outer planets will ultimately settle the matter if, that is, the hypothetical body, or bodies, exist. It is interesting to compare the material Dr. Lowell finds available with that which led to the capture of Neptune. In the first place, the latter has not yet been known long enough to enable its theory to be developed with the accuracy required as a basis of a search for a source of perturbation, hence instead of the planet next in the series, recourse must be made to the antepenultimate Uranus. Then, secondly, the residuals given by Gaillot's theory of Uranus do not exceed 4·5″ at any point of its path (1709–1910), whilst in 1845 Uranus showed an unexplained discrepancy amounting to 133″. A comparison of the present residuals, small though they be, with the probable errors of observations, shows that they are too large to be due to the latter. By a lengthy process of trial by error Dr. Lowell shows that the hypothesis of a single outside perturbing body can reduce the residuals 71 per cent., or, including errors of observation, by 90 to 100 per cent. Two solutions are found to be equally indicated, one with the unknown situated (July 0, 1914) in heliocentric longitude 84·0°, for the other in 262·8°. The distances, masses, and eccentricities are closely alike, being about forty-four times the earth's distance from the sun, 1/50,000 of the sun's mass, and an eccentricity about 0·2, indicating a visibility of 12–13 magnitude, and a disc greater than 1″ in diameter.

ARTIFICIAL IRRIGATION IN THE WESTERN STATES OF NORTH AMERICA.[1]

THE hydrological department of the United States Geological Survey finds nowhere, perhaps, so important and fruitful a field of operations as in the great tract of country which lies west of the 100th meridian of west longitude. The difficulties attending the agricultural development of regions in which the rainfall is so scanty as to be almost negligible are sufficiently obvious, but the lack of adequate supplies of water is no less felt for mining and industrial purposes, to say nothing of ordinary domestic requirements. Hence arises the necessity for a close and searching investigation into all such sources as are actually available, and the conservation of supplies from streams and wells, so that they may be utilised to the best advantage, with the reduction of waste and loss to a minimum.

Such are the conditions prevailing on the south-eastern portion of the State of Nevada. Large areas of fertile soil lie idle for want of moisture to make them productive, and very little vegetation survives, unaided, the long periods of drought. The average annual precipitation of rain at seven gauging stations in different localities ranges from 3·42 to 11·99 in. When a rainfall does occur, it often takes the form of a cloudburst, in which a large quantity of water falls on a small area in a very short space of time. Much consequently is lost. The majority of the upland streams, moreover, disappear in the alluvial slopes at the foot of the mountains, and only flood waters from heavy rains reach the central valleys. Wells and springs, therefore, constitute some of the most important sources of supply, and they are found to give the best yield in the unconsolidated sedimentary deposits which partly fill the structural basins of the district. The lower indurated strata, forming what is called the "bed-rock," are much less productive. These lower formations are usually hard, compact, and impervious layers, representative of various systems, mostly sedimentary, but with some igneous intrusions. They serve the useful purpose of confining the water which enters the "valley-fill," and of preventing its downward escape.

Tularosa Basin, in New Mexico, with an area of 6000 square miles, is another arid region with similar climatic conditions. The sky is generally clear, the atmosphere dry, and the average rainfall in the lower

[1] "Ground Water in South-Eastern Nevada." By Everett Carpenter (Water Supply Paper 365.) Pp. 86, with diagrams and 5 plates.
"Geology and Water Resources of Tularosa Basin, New Mexico." By O. E. Meinzer and R. F. Hare (Water Supply Paper 343.) Pp. 316, with diagrams and 19 plates.
"Springs of California." By Gerald A. Waring (Water Supply Paper 338.) Pp. 410, with diagrams and 13 plates.
"Ground Water for Irrigation in the Sacramento Valley, California." By Kirk Bryan (Water Supply Paper 375 A.) Pp. 49, with diagrams and 2 plates.
"Ground Water Resources of the Niles Cone and Adjacent Areas, California." By W. O. Clark (Water Supply Paper 345 H.) Pp. 43, with diagrams and 9 plates.
(Issued by United States Geological Survey, Washington, 1915.)

parts is only about 10 in. per annum. The valley possesses considerable mineral wealth, including gold, copper, lead, iron, turquoise, coal, and gypsum. The metalliferous deposits, especially gold, have been extensively worked. But, from an agricultural point of view, the district has been practically neglected. Vast tracts of arable land, capable of producing valuable crops, lie uncultivated for lack of treatment. In any system of development, artificial irrigation would, of course, be a necessity, but there are abundant stores of underground water available for exploitation and use. As in south-eastern Nevada, these supplies are more prolific in the "valley-fill" than in the "bedrock." The most important sources are the sand and gravel deposits, which lie in irregular lenticular masses at different depths in different localities. The Cretaceous rocks, however, underlying the eastern portion of the basin, yield a sufficient supply for domestic and cattle-raising purposes.

Further to the west lies the great State of California, second only to Texas in point of size, and characterised by a remarkable physiographical diversity. Thus it encloses both the highest and the lowest levels in the Union, viz., 14,501 ft. above the sea (Mount Whitney), and 276 ft. below the same datum (Death Valley). There are equally diverse hydrographic features. In the southern deserts is to be found the extreme of aridity: a rainfall which averages less than 3 in. per annum, and, in some years, is merely a trace; whereas, in the north-west, there is very heavy precipitation, amounting to an annual average of close on 100 in. at certain stations. Mr. Waring's paper contains a very full account of the natural springs scattered throughout the State, with an interesting study of their occurrence and yield. The hot springs are perhaps the most remarkable class, and these include all springs having a temperature higher than about 90° F. Other groups of springs include carbonated springs, sulphur springs, saline springs, magnesic springs, and iron springs, each class named after the constituent which marks the flavour and character of the water. One curious spring is the so-called "poison spring" on the western border of Death Valley, which is an arm of the Colorado Desert. It yields a salty water, impregnated probably with sulphates, producing a strong feeling of nausea in anyone imbibing it. Other popularly described "poison" springs are believed to contain arsenic, but of this there is some doubt, as arsenic is a rare constituent of water and seldom present in measurable amount.

The most prominent topographical feature of California is the Great Central Valley, 16,000 square miles in area, flanked on each side by mountain ranges running parallel with the coast. One portion of this is the Sacramento Valley, a broad and fertile plain lying between the Sierra Nevada and the Coast Range. It is a district unmistakably adapted to agricultural pursuits, possessing climatic conditions of the most favourable kind. The winters are moderate, and the rainfall, which averages from 20 to 25 in. annually, is concentrated, in a large measure, within the five months of their duration. The orchard industry has acquired special prominence. All deciduous fruits bear heavy crops, being rarely damaged by frost, while the more delicate varieties, such as apricots, almonds, olives, etc., flourish in suitable localities. Under normal conditions it is quite unnecessary to resort to artificial irrigation, but, as a means to the more extended and intensive cultivation of ground crops and the inclusion under operation of certain lands at present only available for grazing, the study of water storage and distribution is receiving attention. The ground water is principally contained in the uppermost alluvial deposits, and the valley is remarkable for the large area in which the water-level stands near the surface of the ground. The alluvium is of two periods: an older deposition dating from the Pliocene epoch and continuing into the Pleistocene, and a later deposit of more recent formation. This latter is the most productive water-bearing stratum, and consists largely of sands and gravels in an uncemented condition. The total quantity of ground water in the valley is undoubtedly very considerable, and the application of irrigation from this source presents great possibilities of development.

Adjacent to the Sacramento Valley, on the eastern side of San Francisco Bay, is situated a somewhat notable cone of alluvial deposit, built up by a neighbouring creek, and called, from its proximity to a town of the name, Niles Cone. The cone proper is 11,800 acres in extent, but a marsh tract adds 9000 acres to the area forming the ground-water district covered by Mr. Clark's report. The creek from which the cone derives its origin is Alameda Creek, at the outlet of the Santa Clara Valley. This receives the drainage of 640 square miles of mountains and interior valleys. The alluvial deposits have been brought down by streams during periods of irregular flow. The upper layers belong to the Pleistocene and Recent series of the Quaternary system; the lower strata form part of the Orinda formation in the Pliocene series. Below these fresh-water deposits lie shale and sandstone of the Cretaceous, and, possibly, of the Jurassic periods. The development of artificial irrigation is proceeding rapidly, and numerous wells have been sunk during the past few years, but the limit of yield from the ground water has almost been attained, and any further supplies will have to be obtained by conserving the large quantities of flood water which have hitherto been allowed to run to waste. B. C.

SOME RECENT STUDIES ON PROTOZOA AND DISEASE.

DR. J. W. SCOTT MACFIE describes in *Annals of Tropical Medicine and Parasitology* (vol. ix., No. 4) a number of interesting protozoa from Accra, West Africa. He records the occurrence of a piroplasm—*Nuttallia decumani*, n. sp.—in the blood of brown rats, and gives an account of a case of amœbic dysentery in a monkey (Cercopithecus), in which numerous Entamœba were present, together with a vast number of minute spirochætes. He designates as a new variety (var. *equinum*) a strain of *Trypanosoma congoiense*, chiefly on the ground that in many of the trypanosomes the trophonucleus lies near the anterior end. The clinical aspect of the disease produced by this trypanosome in the original host—a mare—was also peculiar in that there appeared on the skin of the body raised disc-like patches or plaques, which, however, disappeared after about three days. Dr. Macfie also records observations on two mules suffering from a form of trypanosomiasis clinically resembling acute dourine, and states that in these cases infection by coitus—the usual method of transmission of this disease—may be excluded with certainty.

An account of researches by Drs. Fantham and Porter on induced herpetomoniasis in birds appears in the same number of the Annals. Water-scorpions and gnats, in the intestine of which the flagellate parasite Herpetomonas was present, were fed to birds—canaries, sparrows, and martins. A fatal infection of the birds ensued, and herpetomonads, flagellate and non-flagellate, were found in the internal organs (liver, spleen, bone-marrow, etc.). The disease ran either an acute or a chronic course. In acute cases the flagellate form of the parasite was more common in the birds at death, while in chronic cases the non-

flagellate forms—often Leishmania-like—were more numerous. The authors recall the fact that a flagellate stage of *Leishmania donovani*—the causal organism of kala azar in man—has recently been found by Dr. Wenyon in a dog subinoculated with a strain derived from a human case, and that flagellate stages of *L. tropica*—the organism of oriental sore—have been found in man. In view of the similarity of the morphological cycles of Leishmania and Herpetomonas, the authors suggest that the species of Leishmania are probably insect herpetomonads introduced long ago into man, and usually perpetuating the non-flagellate and relatively non-resistant forms, though capable of assuming the flagellate form.

THE NEW ZEALAND INSTITUTE.

THE forty-seventh volume of the Transactions and Proceedings of the New Zealand Institute constitutes a record of much valuable and painstaking research, dealing chiefly with the fauna and flora of the Dominion. It is gratifying to find that the war has interfered so little with the activities of New Zealand naturalists, and that so many ardent workers are now engaged in adding to our already very extensive knowledge of this important region. Most of the papers in this volume are of a systematic character, and probably work of this kind is the most important that can be undertaken at the present time in New Zealand. Such papers, however, naturally appeal to a very limited number of readers, especially when they are written in the ultra-technical language which so many systematists seem to prefer. This appears very markedly in Mr. Meyrick's revision of New Zealand Tineina, in which the diagnosis of the very first genus contains the following cryptic sentence—if sentence it can be called:—"Hindwings under 1, termen abruptly emarginate beneath acutely produced apex; 3 and 4 rather approximated, 5 nearly parallel, 6 and 7 rather approximated towards base."

We cannot help thinking that, apart altogether from the question of style, a somewhat more generous expenditure of type would be appreciated by those who might like to take up the study of this group of Lepidoptera in New Zealand, and are not already experts in the subject. Mr. Meyrick is of opinion that there still remain a large number of additional species of Tineina to be discovered in New Zealand, and it seems a pity, therefore, that the generic and family characters given only hold good for the New Zealand species, for apparently they may be upset at any time by further discoveries, and may prove quite inadequate for the determination of new forms.

One of the most interesting discoveries recorded in the volume is that of a new genus of gymnoblastic hydroids, Ascidioclava, found living as a parasite in the peripharyngeal groove of an Ascidian, and described by Prof. H. B. Kirk.

We are glad to see that local botanists are paying attention to the life-history of the Lycopodiaceæ, which form such an important element in the New Zealand flora. Mr. J. E. Holloway contributes a note on the protocorm of *Lycopodium laterale*, and Miss K. V. Edgerley describes the prothallia of three species. Prof. Charles Chilton gives an interesting account of the recently established Mountain Biological Station belonging to the Canterbury College, the existence of which may be expected to do much to promote biological research.

It is impossible in a short notice to do justice to such a mass of valuable material as this volume contains. We can only express our satisfaction at the great activity displayed, and congratulate all concerned on the results of their labours. A. D.

THERAPEUTIC ACTION OF ULTRA-VIOLET RAYS.

ATTENTION has recently been directed again to the therapeutic action of ultra-violet rays by the publication of a paper in the *Lancet* of January 8, in which a source of light invented by Mr. Simpson was referred to. There is nothing novel, of course, in the fact that certain forms of disease may be cured by exposure to light of wave-length ranging from 300 $\mu\mu$ to 90 $\mu\mu$, but the discovery of a new ultra-violet lamp raises many questions of wide interest. Dr. Sidney Russ has now shown, however, that an arc simply produced between two tungsten rods exactly simulates the so-called "Simpson light," and it is evident that the powerful source of ultra-violet rays thus obtained will prove of service in the treatment of all those superficial lesions which Finsen and others have proved to be favourably affected by this type of radiation. Dr. Russ has further pointed out that even one-tenth of a millimetre of human skin readily absorbs a large part of the ultra-violet rays from this arc, and that less than one per cent. passes to a depth of one millimetre.

When its spectrum is compared with that of the mercury arc, the carbon arc, or one between copper and silver, it is seen to consist of numerous lines grading off towards the shortest wave-length, and affording an exceptionally rich source of ultra-violet light over the region, which is of great therapeutic use. In medical work, however, the cleanliness and convenience of the method by which any particular radiation can be produced are naturally of great importance, and in this respect it is evident that the electric discharge between a broken column of mercury enclosed in an exhausted quartz tube has much to recommend it. On the other hand, the new tungsten arc lamp made by Messrs. Edison and Swan (see NATURE of December 23, 1915, p. 467), enclosed in a silica bulb instead of in glass, would no doubt be an ideal means of producing ultra-violet light, and one which could be readily adapted for medical as well as other purposes.

Dr. Russ has contributed a short illustrated article to the *British Medical Journal* for January 22, in which some interesting points are considered respecting the seventeen octaves of radiations which are now available: from visible light to the gamma rays of radium. He deals very clearly with the X-ray spectrum, the dangers of prolonged or frequent exposure to that radiation, ultra-violet light, and some of the chief physical facts with which medical students should become acquainted.

THE UTILISATION OF PEAT.[1]

PEAT AS A SOURCE OF POWER.

THE problem of the utilisation of peat for industrial purposes is one of perpetually recurring interest, and scientific men in many countries have turned their attention to search out a solution. This is not surprising in view of the fact that the amount of combustible matter in the world's peat deposits exceeds that of all the known coal-fields. For Ireland the question is one of vital interest. Her coal deposits are small and relatively unimportant, while nearly one-seventh of the area of the country, *i.e.* more than two and three-quarter million acres, is covered with peat, much of which is of excellent quality. This represents a vast amount of potential energy awaiting only a practical means of utilising it.

[1] Abridged from articles entitled "Peat as a Source of Power," by Mr. George Fletcher, and "Some Chemical Aspects of the Peat Problem," by Prof. G. T. Morgan, F.R.S., published in the Journal of the Department of Agriculture and Technical Instruction for Ireland (vol. xvi., No. 1).

The defects of peat as a fuel are (1) that it contains and retains a large amount of water; (2) it has, compared with other fuels, a low calorific value; and (3) it is extremely bulky, involving a high cost of carriage. Thus it is that most of the schemes for peat utilisation have been concerned with artificially drying and compressing the material. This can be done readily enough, but the energy consumed in the operation, and the low calorific value of peat, render the commercial success of any such scheme extremely problematical. Other schemes have sought to combine the preparation of a fuel from peat with the extraction of by-products. When one recalls the fact that the by-products of the manufacture of coal gas, once regarded as useless, have come to rival the gas itself in value, this aspect of the peat problem appears full of possibilities; further reference will be made to this.

interest to refer to two instances where peat has been used in plant designed to recover the by-products.

The first of these is the power plant of the Societa per L'Utilisazzione du Combustibili Italiani, at Orentano in Italy. This plant, erected by the Power Gas Corporation, Ltd., Stockton-on-Tees, is situated on the edge of a bog a few miles distant from Orentano. The area of the bog is about 1482 acres, of which the company operating the recovery power plant owns about 500 acres. This portion of the bog has an average depth of about 5 ft. of good peat fuel. The bog has to be drained by pumping. The peat, excavated by manual labour, is fed into Dolberg peat machines, and these are provided with belt conveyers to transport the peat to the macerators. Part of it is air-dried, and part mechanically treated and artificially dried. The peat delivered to the producers with an average moisture content of $33\frac{1}{2}$ per

FIG. 1.—Producer gas plant, utilising peat, at Messrs. Hamilton Robb's factory at Portadown.

A new vista of potentialities for peat has opened up in recent years. Just as the nineteenth century will always be associated with the development of the steam engine, culminating in the steam turbine, so will the twentieth century be able to claim the triumph of the internal-combustion engine. The success of the gas engine has led to investigations which resulted in the many forms of producer gas plant, and there are now many thousands of installations of this method of producing power for mechanical purposes.

It is a noteworthy and encouraging fact that an installation at Portadown for utilising peat in gas-producer plant has been found to be entirely satisfactory, and to effect a considerable saving over anthracite. This is the more remarkable, as the by-products are not at present utilised. But these by-products are of considerable value, and it will be of

cent., has an average nitrogen content of 1·04 per cent. The nitrogen is recovered as ammonium sulphate, and the gas is used to drive two gas engines of 350 metric horse-power each, which drive alternate-current generators—there being a transmission line to Pontedera, ten miles distant.

The second installation referred to is the ammonia recovery power plant of the German Mond Gas Company, situated on the Schweger Moor, about twenty-five miles from the city of Osnabrück. It is constructed according to the system of Frank and Caro, and was designed to utilise peat containing upwards of 60 per cent. moisture—an important point as lengthening the season during which peat manufacturing operations could be carried on. The gas plant is capable of gasifying and recovering the by-products from 210 tons per day of twenty-four hours of air-

dried peat. The total power capacity is more than 3000 h.p., and the gas engines are coupled to alternators running in parallel. The current, transmitted at a tension of 30,000 volts, is distributed over an area of about twenty-five miles' radius.

If more rapid progress has not been made in solving the problem in the United Kingdom, it must be remembered that in the manufacturing parts of England coal is comparatively cheap, and owing to its greater heating power is more suitable for producer gas than is peat. In many parts of Ireland, however, coal is very dear, but (and to some extent because of this fact) in these districts we have not at present in existence industries demanding power. The possibility of securing cheap power would be a stimulus to industrial development.

Happily, a noteworthy step has been taken in the way of solving the problem by the action of Messrs. Hamilton Robb, of Portadown. This firm have in Portadown a weaving industry, and a little more than four years ago decided to try the experiment of establishing a (peat) producer gas plant. They accordingly installed a suction gas plant constructed by Messrs. Crossley Brothers, Ltd., of Manchester, of a capacity of 400 brake-horse-power. The fuel used is peat, and this is cut from a bog some miles distant and dried in the open air by the usual method of stacking. The plant supplies gas to two engines, each of 120 b.h.p., and one of 150 b.h.p. There are two producers, each having a capacity of 200 b.h.p. By means of the conveyer the peat blocks are elevated and carried to the feed hoppers on the top of the producers, from which they pass into the generators, where gasification takes place. It is stated that under working conditions, with peat at 5*s*. a ton, power can be obtained at the rate of one-sixteenth of a penny per horse-power hour.

The gas, before passing to the engine, must be purified, but the substances removed are valuable, although the by-products of a small plant would not justify treatment. There is nitrogen, which can be recovered as ammonium sulphate, and also peat ash and peat tar, containing valuable constituents. It is not unreasonable to assume that with an extension of this method of utilising peat, it would be possible to deal in a profitable manner with the by-products which would thus be produced in a sufficient quantity to allow of their being dealt with in chemical works. We should in this way not only establish an additional industry, but this method of obtaining power from peat would be rendered still more profitable.

It may be said that the conditions at Portadown are favourable, in view of the neighbourhood of the peat bog to the weaving factory, and it is undoubtedly a very great advantage to be able to avail of water carriage from the bog to the factory. There are, nevertheless, without doubt, many other places in Ireland where corresponding advantages could be found. But even in their absence it seems certain that peat could be profitably utilised on the lines indicated, with one modification, though that is an important one. Where a sufficient demand for power exists, it appears certain that instead of carrying the bulky peat either by road or by water, it would be advisable to instal producer plant on the bog itself and to convert the mechanical power into electricity, and transmit the energy at high pressure to the point where it is required. The efficiency of such conversion and transmission is now very high, and the financial results of such a mode of transmission can be ascertained with a considerable degree of accuracy in any case where the conditions can be stated.

FIG. 2.—The first producer plant in the world making regularly producer gas and ammonium sulphate from wet peat, containing up to 75 per cent. of water.

Chemical Aspects of the Peat Problem.

Extensive deposits of peat exist in Great Britain, France, Russia, Italy, Scandinavia, Germany, and Austria. One-seventh of the total area of Ireland is covered by peat, and enormous tracts of this deposit are found in Canada.

Only two years before the outbreak of war a practical solution of the peat problem was claimed for Germany by Dr. Carl Duisberg, of Elberfeld, who at the Congress of Applied Chemistry held in 1912 at New York, stated his case in the following words:—

"The latest and most rational method of utilising the peat or turf beds which are so plentiful in Germany and many other countries is practised in Schweger Moor near Osnabrück, according to a process discovered by Frank and Caro. There peat gas is produced and utilised, and ammonia obtained as a by-product, the required power being generated in a 3000-h.p. central electric power station. The moorland, after removal of the peat, is rendered serviceable for agricultural purposes."

The foregoing development appears to be a practical realisation of the view held by many workers on peat in this country, that the most economical use to make of this combustible is to convert it into gaseous fuel in suitable gas producers.

When peat is gasified the products are combustible gas, ammonia, ash, tar, and an aqueous distillate containing certain technically important organic compounds. The combustible gas, which is generally free from sulphur, consists of carbon monoxide and hydrogen mixed with the non-combustible gases, nitrogen and carbon dioxide.

At present the only plant of this description in Ireland is the gas-producer furnishing the gaseous fuel for the gas engines of the factory of Messrs. Hamilton Robb, Ltd., of Portadown, and although, on account of the comparatively small capacity of the plant, no attempt is made to recover and utilise any by-products, yet, nevertheless, this installation has proved to be a financial success. There can be little doubt that in a scientifically controlled plant, large enough to render practicable the recovery of ammonia and other by-products, the economy effected would be considerably greater.

By-Products from the Peat-Gas Producer.

Ammonia.—Peat may contain from 0·5 to 2·5 per cent. of nitrogen, and by passing steam over peat heated to 350–550° almost the whole of the nitrogen is obtained as ammonia. This improvement has been embodied in the modern types of Mond plant, so that now it is possible to recover the greater part of the nitrogen of peat in the form of the valuable fertiliser, ammonium sulphate. The importance of increasing the output of ammonium sulphate from peat lies in the circumstance that this salt can displace sodium nitrate as a nitrogenous manure, thus rendering the nitrate available for the manufacture of explosives and other chemical products.

The Power-Gas Corporation, Limited, of Stockton-on-Tees, who in 1905 first turned their attention to this method of utilising peat, have obtained the following extremely favourable results:—

Fuel used	German peat per cent.	Italian peat per cent.	English peat per cent.
Moisture content of fuel... ...	40 to 60	15	57·5
Nitrogen content of fuel	1·0	1·58	2·3
Quantity of gas produced per ton of theoretically dry peat.	cubic ft. 85,000	cubic ft. 60.000	cubic ft. 90,000
Heat value of gas produced ...	B.T.U. per c.f. 150	B.T.U. per c.f. 166	B.T.U. per c.f. 134
Sulphate of ammonia produced per ton of theoretically dry peat	70 lb.	115 lb	215 lb.

The Simon-Carves Bye-product Coke-Oven Construction and Working Company, Limited, have made large-scale experiments on the gasification of peat in Moore gas-producers. Peat, containing 63 per cent. of moisture and with a nitrogen content of 2·235 per cent., yielded per ton 94,850 cubic ft. of gas (100 B.T.U. per cubic ft.) and 168 lb. of ammonium sulphate.

Peat Ash.—Peat differs from wood in yielding on combustion a comparatively large proportion of mineral ash (5 to 15 per cent.). The ash of peat contains the oxides of aluminium, iron, and calcium existing to a considerable extent in the form of carbonate, sulphate, silicate, and phosphate, a very appreciable amount of alkalis, with a preponderance of potash. By using the peat ash as a dressing for the recovered land the potash locked up in peat would be rendered available for agriculture at a time when the shortage of this alkali is felt very acutely.

Peat-producer Tar.—The incomplete combustion of peat in the producer leads to the formation of a certain proportion of tar which is collected in the hydraulic scrubbers of the plant.

The amount of tar produced yearly in the Portadown plant is about one hundred tons. Samples of this waste product were examined in the chemical laboratories of the Royal College of Science for Ireland, when substances of industrial importance were isolated.

A greatly increased output of the peat tar is, however, the first essential step towards commercial success in this direction. Ten installations comparable in size with that of Messrs. Hamilton Robb, Ltd., would yield approximately an annual output of 1000 tons of peat-producer tar, a quantity which would furnish a practical basis for the industrial exploitation of the derivatives of this tar.

Distillation of the moist crude producer tar effected a separation of certain volatile oils from a non-volatile bituminous material (crude pitch) amounting to about 17 per cent. of the total tar. By heating the crude pitch to 122° C. and pouring off the liquid portion, about 6 per cent. of a refined soft pitch could be separated from a solid friable carbonaceous residue.

This pitch, either alone or mixed with the carbonaceous matter, could be used as asphalt, as a caulking material, or as an insulator in electrical work. The carbonaceous matter could be utilised separately as a self-briquetting combustible of high calorific value.

The moist peat-producer tar yielded on distillation 50 per cent. of volatile oils; the latter by further treatment were separated into neutral oils, waxes, and acidic oils.

Acidic Oils.—Fractional distillation of the acidic oils showed that these substances consisted principally of complex phenolic compounds. Attention was specially directed to these substances as they seemed likely to afford material for the manufacture of useful disinfectants comparable in efficacy with lysol, creolin, cyllin, and other coal-tar disinfectants.

The well-known Rideal-Walker test for disinfectants and the modified procedure devised by Martin and Chick afford methods for controlling quantitatively the separation of the germicidally active acidic oils from peat tar, and for ascertaining the bactericidal value of these acidic oils. Phenol and the cresols are segregated in the fraction boiling below 200° C., which is about seven times as toxic as phenol itself towards *Bacillus typhosus*. The fraction of acidic peat oil boiling at 200–250° is seventeen times as active as phenol (carbolic acid) on the same pathogenic organism.

The most intense germicidal activity is possessed by the fraction of acidic peat oil boiling at 253–360°, for this product has a phenol (carbolic acid) coefficient of 31.

These results show that by distillation and simple

chemical treatment of the oils obtainable from peat-producer tar one can, under appropriate bacteriological control, isolate oils of intense bactericidal activity suitable for the manufacture of antiseptics, disinfectants, and germicides. When it is remembered that phenol (carbolic acid), the standard disinfectant of this type, is greatly required in the manufacture of explosives (lyddite), drugs (salicylic acid, aspirin, etc.), as well as for many other synthetic products, it will be readily realised that these peat disinfectants would be welcomed as efficacious substitutes for carbolic acid, if they were forthcoming in sufficient amount, especially at the present time, when antiseptics are so urgently needed.

The neutral oils left after extracting the germicidal acidic oils with alkali could be used as lubricants, as liquid fuel, for example, in Diesel engines, and when mixed with the pitch from peat tar would furnish a refined tar.

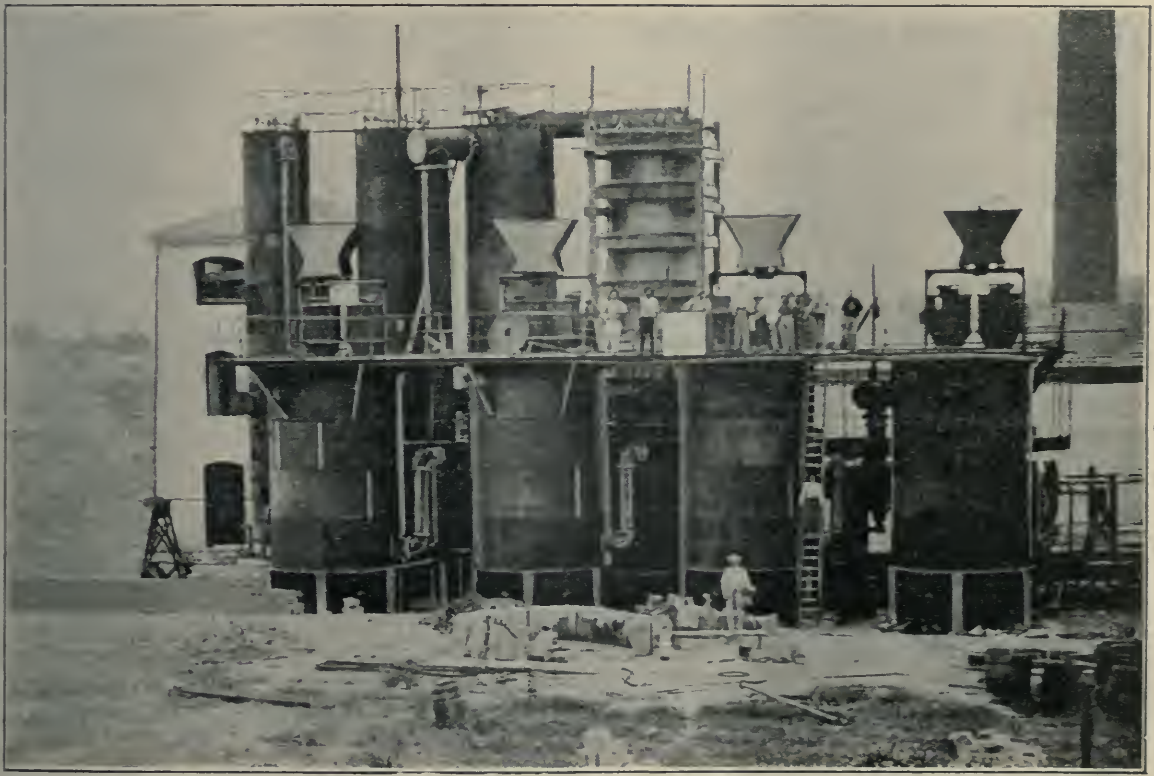
The higher fractions of the neutral oils boiling above 250° C. deposit on cooling considerable quantities of almost colourless wax, which would serve as a promising starting point for the manufacture of candles.

The aqueous distillate from the producer contains, in addition to ammonia, certain organic substances soluble in water, among which have been recognised methyl alcohol, acetone, acetic acid and its immediate homologues, and pyridine bases. Methyl alcohol is an important solvent and the starting point for formaldehyde. Acetic acid and its homologues are required for the manufacture of acetone and other ketones. Acetone is an important solvent used in considerable quantities in the manufacture of the explosive, cordite. The pyridine bases are pungent liquids useful both as solvents and as disinfectants. The recovery of these compounds could be rendered practicable by suitably modifying the peat-producer plant.

SUMMARY.

1. The industrialisation of peat could be most efficiently brought about by gasifying it in gas producers, as this procedure would render feasible the recovery of several valuable by-products.

2. The combined nitrogen of the peat can be economically recovered in the form of ammonium sulphate. This valuable fertiliser, together with the peat ash containing potash and phosphoric acid, could be restored to the land from which the peat has been taken.



The Power Gas Corporation, Ltd., Stockton-on-Tees.

FIG. 3.—Mond peat power gas plant, with ammonia recovery, designed to gasify about 100 tons peat per day. In operation at a Central Electric Station, Pontedera, Italy.

3. Peat tar, another by-product, can be fractionated into the following useful materials:—Refined pitch and tar, candle wax, lubricating and burning oils, and very powerful disinfectants, greatly exceeding carbolic acid in germicidal strength.

4. The aqueous distillate from the producer contains methyl alcohol, acetone, pyridine bases, and crude acetic acid, all of which are capable of recovery and utilisation.

The economical utilisation of peat in the generation of gaseous fuel, even without recovery of by-products, is to-day an accomplished fact. It can scarcely be doubted that, with efficient chemical control, a larger plant of sufficient capacity to deal rationally with the ammonia, tar, and other products of the destructive distillation of peat would lead to still greater economies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the annual meeting of the Court of Governors, held on February 24, the Vice-Chancellor referred to the services rendered by the University to the country in the prosecution of the war. Not only was the staff able to render valuable help in undertaking scientific work and serving on public bodies, but in addition something like 500 present and past students had joined the Services, and of these nearly 10 per cent. had already lost their lives.

The principal, Sir Oliver Lodge, referring to the unwisdom of false economy in education and scientific training and investigation, said:—"It has certainly been one of our dangers that the country as a whole has not been wide awake in this direction, and has been contented with a singular kind of ignorance on the part of otherwise educated people—even of people in high position. The services which the universities of the country have been able to render during the war have been already very marked, and might have been greater had they had facilities from the first. It seems unlikely that the country will allow these institutions to drop back into a position continuously handicapped by inadequate resources. They are not only educational; they are repositories of learning and of a special kind of ability not elsewhere cultivated. Knowledge is not a thing to be merely passed on to a coming generation, it is a thing to be utilised and increased and applied by every generation; and if the occupants of university posts—especially the younger members—are prevented from doing their duty and realising their privilege in this respect, the country cannot keep its place in the van of civilisation."

In view of the increased intercourse between this country and Russia which may be anticipated after the war, it is hoped that the teaching of Russian may be undertaken by the University, but shortage of funds will not allow this step at present.

The treasurer reported that the income was reduced by 9200*l.* owing to the war, and of this amount 7700*l.* was due to loss of fees.

The following were elected members of the council:—The Bishop of Birmingham, Mr. Richard Threlfall, Miss S. M. Fry, and Dr. F. D. Chattaway.

CAMBRIDGE.—The Raymond Horton-Smith prize has been awarded to Dr. E. Mellanby for a thesis entitled "An Experimental Investigation into the Cause and Treatment of Diarrhœa and Vomiting in Children."

The Degree Committee of the Special Board for Mathematics is of opinion that the work submitted by Mr. S. Ramanujan, of Trinity College, entitled "Highly Composite Numbers," together with six other papers, is of merit as a record of original research; this gentleman was sent to the University by the Indian Government on account of his remarkable mathematical powers.

The Vice-Chancellor has given notice that the subject for the Sedgwick prize essay for the year 1919 is "The Lower Palæozoic Rocks of Some British District."

OXFORD.—The subject of Prof. Mark Baldwin's Romanes lecture is "The Super-State and the 'Eternal Values.'" The lecture will be delivered in the University Museum on Wednesday, March 15, at 2.30.

Like other departments of the University, the school of forestry has been seriously affected by the war. Eight students, however, have received the diploma in the course of 1915, and the professor has conducted visits to the Forest of Dean, the Tintern Crown Forests, and other areas, in addition to the usual excursions for instruction to Bagley Wood. Planting and thinning has continued in the experimental plots, and Mr. W. E. Hiley has continued his research on fungal diseases of trees. The publication of his work on the diseases of the larch may suffer some delay from the fact that Mr. Hiley has accepted a commission as scientific worker at Woolwich Arsenal.

It has often been thought by many of those who are interested in the progress of science at Oxford that the examinations for honours in natural science were framed too much on the model of those belonging to the older academic subjects. A statute which will come before Congregation on March 7 marks a new departure in this respect, so far as concerns the honour school of chemistry. The object of the statute is to ensure that every candidate for honours in chemistry shall not only be examined in paper and practical work as at present, but must also produce records of experimental investigations carried out under the supervision of the Waynflete or Lee's professor, or of other approved persons. This provision is in accordance with a memorandum lately drawn up by the Board of Natural Science, in which it is pointed out that some practical acquaintance with the methods of research is an essential part of the training of every chemist. The statute is regarded by many as a long step in the right direction, and it is to be hoped that no obstacles will be thrown in the way of its passing.

A PLAN for the development of the University of California Medical School has been adopted by the regents of the University of California. We learn from the issue of *Science* for February 4 that the University of California has now increased to a total of 32,400*l.* per annum its expenditure on medical instruction, over and above the hospital receipts, and within the next few months it will complete the erection, at a cost of 123,000*l.*, of a new 216-bed teaching hospital. The regents have now outlined as the immediate future needs of the medical school a new laboratory building for anatomy and pathology, to cost 30,000*l.*; an "out-patient" building in conjunction with the new teaching hospital, to cost 20,000*l.*; and a nurses' home for 100 nurses, to cost 20,000*l.*

THE second annual report, for the year ending December 31, 1915, of the executive committee to the trustees of the Carnegie United Kingdom Trust has now been circulated. The trust deed expressly prohibits "any part of the trust funds from being used in any way which could lend countenance to war or to warlike preparations." This fact prevents the trustees, in their corporate capacity, taking any part in the activities in which the country is chiefly involved at present. Prior to the date of the last annual report a total sum of 550,000*l.* had been expended or promised for the provision of church organs; when to this sum is added the grant promises made during the year, a total sum of about 600,000*l.* will have been expended in this way and about 3800 organs will have been procured. No further applications for organs are to be entertained. The executive committee has decided that the library movement which is being carried out can best be dealt with under the heads: rural library grants, grants for special libraries of a national character, loan charge grants to public libraries, and grants for public library buildings. In the case of rural libraries, a number of experimental schemes have been set on foot of which particulars are given in the report. During the year the committee has assisted in the establishment of a central lending library for students, has rendered assistance to the agricultural library attached to the Rothamsted Experimental Station, and has promised assistance towards the more commodious housing of the British Library of Political Science attached to the London

School of Economics. Among miscellaneous grants made during the year may be mentioned a sum of 1500*l*. to the United Irish Women, and 4000*l*. to the Women's Industrial Council towards the cost of building a nursery training school; and to provide an aquarium for the gardens of the Zoological Society of Scotland 10,000*l*. is to be given.

How unwise it would be if the present demand for national retrenchment led to any reduction of State aid to our modern universities can be gathered from an inspiring article by a special correspondent in the issue of the *Times* for February 9. The impressive array of facts as to the value of the application of research to the purposes of the war which the article provides shows that those nations will take the first rank in peace and war alike which utilise most completely the resources which science has placed at the disposal of mankind. The article deals more especially with the four universities of the North of England, and we select the following instances from the numerous examples cited:—Distillations from coal tar, testing of steel and explosives, calibrating of aeroplane recording instruments, and the production of pharmaceutical drugs are included among the special war enterprises of Manchester University. Liverpool University has given expert advice in the manufacture of explosives, and has undertaken the analysis of explosives in a district extending from Ruabon to Fleetwood. The equipment and *personnel* of the tinctorial chemistry and dyeing department of Leeds University were put at the disposal of the Government in 1914, and the department has done valuable research work in relation to dye-stuffs and raw materials not hitherto made in England. Another department of this University is conducting the recovery of toluene from coal gas in Lincolnshire and Yorkshire, and is inspecting the production of high explosives in Yorkshire. The chemists of the University have furnished a large supply of the anæsthetic novocaine, which we formerly imported from Germany, and have prepared about a hundred antiseptic compounds for the military hospitals. In regard to the University of Sheffield, valuable and confidential work has been done there in relation to the science of steel, and the Scientific Advisory Committee of the University has given local manufacturers expert guidance in their efforts to replace exports from Germany. Thus, advice has been given on the processes of hardening steel, on materials for polishing razors, on the contact process of procuring sulphuric acid, and so forth. Steps have been taken also to encourage the revival of the old glass industry of South Yorkshire.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, February 10.—Sir Joseph Larmor, president, in the chair.—J. H. **Grace**: (i) Theorems on straight lines intersecting at right angles. (ii) The classification of rational approximations.—Mrs. G. C. **Young**: Infinite derivates.—E. H. **Neville**: The bilinear curvature and other functions of independent directions on a surface.—Dr. S. **Brodetsky**: The attraction of equiangular spirals.—J. **Proudman**: Additions and corrections to a former paper, "Limiting forms of long-period tides."—R. E. **Powers**: Certain composite Mersenne's numbers.—Prof. H. F. **Baker**: Note on a formula connected with the theory of spherical harmonics.—Dr. T. J. I'A. **Bromwich**: Note on Dr. Baker's formula.—J. **Hammond**: Notes on the arithmetic of prime numbers.

Royal Meteorological Society, February 16.—Major H. G. Lyons, president, in the chair.—C. E. P. **Brooks**: The rainfall of Nigeria and the Gold Coast. The paper dealt with the rainfall on the Guinea Coast and its hinterland for the ten years 1904–13. The driest month is January, with scarcely any rain, the wettest is June, and the monthly maps show how the rainy belt travels inland as the wet season comes on. In August it reaches its northernmost position, and the coast is drier during that month than in July and September. The coast is very rainy, the annual fall averaging 160 in., and reaching 200 in. in wet years at some stations in the Niger delta. The interior merges into the desert, with a rainfall of less than 10 in. annually. The variation of the rainfall from year to year is governed by the development and movements of the equatorial belt of low pressure and the subtropical "highs," while it is the alternation of dry and wet seasons which governs the temperature and humidity, rather than the position of the sun, and the dominant factor in Nigerian climatology is not temperature, but rain.—Dr. J. R. **Sutton**: South African coast temperatures. This paper dealt with the normal monthly mean temperatures at selected stations on the coast of South Africa, a few miles inland, and on the tableland, and the author endeavoured to connect the retarding of the maximum and minimum temperatures at certain stations with the moderating effect of the temperature of the sea and of the direction and force of the wind.

Linnean Society, February 17.—Prof. E. B. Poulton, president, in the chair.—Miss C. **Herring-Browne**: John Bartram, the pioneer American botanist. Bartram was born on March 23, 1699, near Darby, in County Delaware, Pennsylvania. In 1731 his friend, James Logan, procured a copy of Parkinson's "Theatrum" from England as a present for Bartram, and this decided him to make excursions after plants into Maryland and Delaware. To receive and grow his discoveries he began before the end of the year to lay out the garden, the charm of which was felt by Washington, Jefferson, and Franklin. Many of the American trees were first sent to Europe by Bartram, amongst them being the *Taxodium distichum*, still extant at Mill Hill, in Collinson's old garden. An even finer specimen, which died a few years ago, was 150 ft. high, and 27 ft. in girth; the trunk still stands in the Bartram Garden Park, Philadelphia. Bartram died on September 22, 1777. His life was shortened by the apprehension that his cherished garden might be laid waste by British troops, but his fears were not realised. This garden is now the property of the city of Philadelphia, and is supported as a public park.—E. P. **Stebbing**: The infestation of bamboos in tidal waters by *Balanus amphitrite* and *Teredo navalis* in Tenasserim. The rapid destruction of bamboo piles is a serious loss, and investigation shows that up to now no species of bamboo is immune; research is to be continued.

Institution of Mining and Metallurgy, February 24.—Sir T. K. Rose, president, in the chair.—E. T. **Mellor**: The conglomerates of the Witwatersrand. Of the various theories which have been from time to time advanced to account for the association of the gold with the conglomerates of the Rand, two now hold the field: the infiltration theory and the theory which regards the conglomerates as placer deposits modified by subsequent recrystallisation of many of the constituents. In view of recent extensive developments in prospecting by boreholes and mining, and the evidence accumulated as the result of a survey of the Witwatersrand system during the past five

years, the author submits certain geological aspects of the question which he thinks may assist in forming a conclusion as to the precise nature of the conglomerates and the origin of the gold associated with them. After reviewing the position in the light of these recent investigations, which have, he claims, seriously disturbed the even balance of previously adduced evidence favouring opposing theories, the author considers that the evidence in favour of regarding the conglomerates as "fossil placers" is convincing and is increasing continually with the extension of opportunities for collecting information. The importance of establishing such a theory as fact can scarcely be over-estimated from its bearing upon the future of the Rand goldfields, which have now for some years had a yearly output to the value of approximately 40,000,000*l*. sterling.—H. E. **Nicholls**: A pioneer bucket dredge in northern Nigeria. The chief interest in this account of the installation of the first bucket dredge in northern Nigeria relates to the fact that the dredge in question was, to the author's knowledge, the first to be operated by internal-combustion engines of the semi-Diesel type. The choice of this type of motor was enforced by the local absence of firewood and the then existing prohibitive cost of coal, which seemed to render the use of steam power quite out of the question. The paper gives a full description of the dredge and its engine, and there are also details of the costs of operating and other particulars which should be useful to engineers confronted with similar problems.—A. S. **Wheler**: Antimony production in Hunan Province, South China. In view of the importance of this metal at the present juncture, and the fact that China is the world's largest producer—Hunan being, moreover, the chief source of the Chinese supply, this paper makes a timely appearance. It would seem that, as in most Chinese mining, the processes adopted are of a crude and sometimes even primitive nature, but despite this the production is of great economic value, and of the output it is computed that at least 90 per cent. (about 25,000 tons in the year 1914) is exported to other countries.

MANCHESTER.

Literary and Philosophical Society, February 8.—Prof. S. J. Hickson, president, in the chair.—Prof. G. Elliot **Smith**: New phases of the controversies concerning the Piltdown skull. Prof. Elliot Smith considered the different views that had been recently expressed; (1) that the canine belonged to the upper and not the lower jaw; (2) that the mandible was not human, but that of a hitherto unknown species of chimpanzee, which by some unexplained means made its way into England in the Pleistocene period; (3) that the features differentiating this mandible from that of modern man had been unduly exaggerated; (4) that the canine tooth could not have belonged to the same individual as the skull and the jaw because it differed from them in age, according to one authority being definitely *older,* and to another distinctly *younger,* than the other fragments. These widely divergent views tend to neutralise one another. In considering the possibility that more than one hitherto unknown ape-like man or man-like ape expired in Britain side by side in the Pleistocene period, and left complementary parts, the one of the other, the element of improbability is so enormous as not to be set aside except for the most definite and positive anatomical reasons. The evidence submitted in support of each item of the arguments for the dissociation of the fragments was examined, and it was maintained that none of it was sufficiently strong to bear the enormous weight of improbability which these hypotheses imposed upon it. The author directed special attention to the implied inference that the cranium itself was not sufficiently simian to be associated with the jaw; and emphasised the fact that the skull itself revealed certain features of a more primitive nature than any other known representative of the human family.—W. J. **Perry**: The geographical distribution of terraced cultivation and irrigation. Attention was directed to the stupendous efforts made by various populations in the past, whereby whole mountain-sides were laboriously built up into series of great steps, which in many cases were watered by gigantic irrigation works, so that thousands of acres of what otherwise would have been sterile land were made to produce crops and maintain large populations. Such methods were (and in some instances still are) used in Great Britain and Ireland, Spain, Italy, Switzerland, and South Germany, many of the Mediterranean islands, Phœnicia, Mauretania, Canary Islands and Nigeria, Darfur, East Africa, British Central Africa, Rhodesia, Madagascar, Southern and Central Arabia, India, Ceylon, Burma, Assam, Western China, Sumatra, Nias, Java, Madura, Bali, Lombok, Sumbawa, Luzon, Formosa and Japan, New Guinea, Melanesia, Pelew and Caroline Islands, Marquesas Islands, Hawaii, Lesser Paumotus, Easter Island, Peru, Mexico, Honduras, New Mexico, Western Texas, Arizona, East California, and Haiti. These methods, applied in the same way in this peculiar geographical distribution, and irrespective of whether such highly laborious measures were necessary or not, afford the most positive tokens of the migration of primitive culture along the same routes and probably at the same time as the stone-using, mine-working peoples first intruded into the same localised spots on the surface of the globe.—J. W. **Jackson**: The geographical distribution of the shell-purple industry. One of the most curious uses of shellfish is that of their employment for the production of a purple dye, known to the ancients as "Tyrian purple." The invention of this dye has usually been accredited to the Phœnicians, but Bosanquet has recently shown that it was known to the Minoans of Crete in 1600 B.C. The Phœnicians, however, appear to have been instrumental in spreading the knowledge of the art far and wide; the search for purple-shells was probably one of the motives which led these people to explore areas further afield than their own immediate surroundings. Throughout the Mediterranean, stations for the manufacture of purple were established by these ancient mariners, and evidence is also available of the early practice of the art on the coast of N.W. Africa and in the British Isles (Cornwall and west of Ireland). Eastward of the Mediterranean the knowledge of the art seems to have spread through the Malay region, China, and Japan, as far as Mexico and Central America. In the latter region it was certainly practised in pre-Columbian times, and still survives among the Indians.—J. W. **Jackson**: Shell-trumpets and their distribution in the Old and New World. The employment of shells as horns and trumpets is of very ancient origin. The sites of the past and present uses of these trumpets form a continuous chain from the Mediterranean region, through India and the Pacific Islands to the American continent. As in the case of shell-purple, Crete figures very prominently in the early use of the conch-shell trumpet, it having been associated with Minoan religious worship. From Crete the cult spread, doubtless through Phœnician influence, to numerous places in the Mediterranean, to India, Tibet, China, and Japan, through Indonesia and the Pacific Islands, to the central parts of America. In the Mediterranean, Triton trumpets have been found in Ligurian caves, said to be of Neolithic age. In India the chank-trumpet is used in connection with Hindu temple worship and special sanctity is associated with

he chank itself. The shell-trumpet enters into ceremonies in Malabar, Siam, etc.; and signal-horn shells are used in Japan. In certain of the Pacific Isles their uses are many. In the New World the shell-trumpet was known in pre-Columbian times, and entered into the religious ceremonial of the Aztecs. Ancient Mexican manuscripts provide evidence of its use in temple worship in precisely the same way as in India. The shell-trumpet was also employed by the Incas and other ancient peoples, and survives to-day in several places.

DUBLIN.

Royal Irish Academy, February 14.—Rev. J. P. Mahaffy, president, in the chair.—J. G. **Leathem**: Periodic conformal curve-factors and corner-factors. The paper deals with the repeated conformal representation of the doubly connected region which is bounded internally by a closed curve or polygon and is externally unbounded, upon successive semi-infinite strips of a half-plane. Smooth curves are dealt with by means of periodic conformal curve-factors; and the properties of such curve-factors and some comprehensive formulæ for them are discussed. Periodic corner-factors are defined, and it is shown how they give the required transformation in the case in which the internal boundary is polygonal. The periodic curve-factor is exhibited as the limit of a product of periodic corner-factors, and special types are deduced. The results are interpretable in terms of two-dimensional fields of liquid or electric flow, or electric induction. Fields with logarithmic singularities (sources, vortices, electrodes, etc.) are then discussed, and it is shown how, by a double transformation, such fields can be specified for any region the conformal representation of which has been formulated. Thus the field due to a line-charge in presence of a charged conductor in the form of an elliptic cylinder or a polygonal prism is readily determined, and the method is equally applicable to many other problems of similar type.—G. H. **Carpenter**: The Apterygota of the Seychelles. The collection described was made by members of the Percy Sladen Trust Expedition, and comprises thirteen species of Thysanura and eighteen of Collembola. As only three Apterygota were hitherto recorded from the Seychelles, most of the species now enumerated are regarded as new, and three remarkable Machilids are referred to a new genus. Structural details of the jaws of Isolepisma, Lepidospora, Lepidocampa, Heteromuricus, and Cremastocephalus are given, together with an account of the genital appendages in Lepidospora and Lepidocampa. The presence of the latter genus in the Seychelles is of considerable geographical interest; together with some of the Collembolan genera it indicates Malayan and Indian affinities for the fauna of the granitic islands of the Seychelles proper, while the species from the coral islands of the Farquhar and Aldabra groups have on the whole Malagasy and African relationships.

PARIS.

Academy of Sciences, February 14.—M. Camille Jordan in the chair.—G. **Bigourdan**: A work of F. Viété, supposed to be lost, "l'Harmonicon cœleste."—B. **Baillaud**: Remarks concerning the determination of the difference of longitude between the Observatories of Paris and Washington. An account of the work of the French-American Committee commencing October, 1913, in which wireless signals between Arlington and the Eiffel Tower were utilised. The final result adopted is 5h. 17m. 36·67s.—Henry **Le Chatelier**: The law of solubility. A reply to M. Colson.—T. H. **Gronwall**: Deformation in conformable representation.—Œchsner de **Coninck** and M. **Gérard**: The atomic weight of bismuth. By the reduction of bismuth chloride in hydrogen the value 208·50 was obtained for the atomic weight of bismuth.—L. Fernandez **Navarro**: The discovery of a basalt outcrop in the Sierra de Guadarrama (Spain). This is the only known volcanic outcrop in the centre of the *massif*.—M. **Deprat**: The stratigraphic series in North Tonkin.—Ph. **Glangeaud**: The volcanic Pliocene of the Saut de la Pucelle (Puy-de-Dôme).—V. **Vincent**: The circulation of manganese in natural waters. Manganese is probably present in natural waters as the bicarbonate. The oxides of manganese, in presence of carbon dioxide, do not dissolve to the same extent as the carbonate.—G. **Bourguignon**: The stimulation of nerves by discharges from condensers.—E. **Colardeau** and J. **Richard**: A stereoscopic arrangement for the examination of radiographic proofs, either with normal or pseudoscopic relief.—Ch. J. **Gravier**: The madrepores collected by S.A.S. the Prince of Monaco in the great depths of the North Atlantic.—A. **Vayssière**: A Notochiton and some Gasteropods from the second expedition of Dr. Charcot.—J. **Bounhiol** and L. **Pron**: A case of complete hermaphroditism in *Chrysophrys aurata*.

BOOKS RECEIVED.

The Mathematical Theory of Probabilities and its Application to Frequency Curves and Statistical Methods. By A. Fisher. Translated and edited with the assistance of W. Bonynge. Vol i., Mathematical Probabilities and Homograde Statistics. Pp. xx+171. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Macmillan's Geographical Exercise Books. iv., The Americas. With Questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 6*d*.

Thomas Alva Edison. By F. Rolt-Wheeler. Pp. ix+201. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 2*s*. net.

Board of Agriculture and Fisheries. Fishery Investigations. Series ii., Sea Fisheries. Vol. iii., No. 2. Report on Sexual Differentiation in the Biology and Distribution of Plaice in the North Sea. By A. E. Hefford. Pp. 73. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s*.

National Health Insurance. Medical Research Committee. Report of the Special Advisory Committee upon Bacteriological Studies of Cerebro-spinal Fever during the Epidemic of 1915. Pp. 64. (London: H.M.S.O.; Wyman and Sons, Ltd.) 6*d*.

Napier Tercentenary Memorial Volume. Edited by Dr. C. G. Knott. Pp. xi+441. (London: Published for the Royal Society of Edinburgh by Longmans and Co.) 21*s*. net.

Wireless Transmission of Photographs. By M. J. Martin. Pp. xi+117. (London: Wireless Press, Ltd.) 2*s*. 6*d*. net.

Harvey's Views on the Use of the Circulation of the Blood. By Prof. J. G. Curtis. Pp. xi+194. (New York: Columbia University Press; London: Oxford University Press.) 6*s*. 6*d*. net.

The Athenæum Subject Index to Periodicals, 1915. Science and Technology, with Special Reference to the War in its Technological Aspects. Pp. 79. (London: Athenæum Office.) 2*s*. 6*d*. net.

Woburn Experimental Fruit Farm. Fifteenth Report of the Woburn Experimental Fruit Farm. Pp. 83. (London: Amalgamated Press, Ltd.) 2*s*. 3*d*.

British Fungi and How to Identify Them. By J. H. Crabtree. Pp. 62. (London: C. H. Kelly.) 1*s*. net.

Instincts of the Herd in Peace and War. By W. Trotter. Pp. 213. (London: T. Fisher Unwin, Ltd.) 3*s*. 6*d*. net.

Examples in Magnetism for Students of Physics and Engineering. By Prof. F. E. Austin. Second edition. Pp. 90. (Hanover, N.H.: Prof. F. E. Austin; London: E. and F. N. Spon, Ltd.) 1 dollar 10 cents.

A New Table of Seven-Place Logarithms of all Numbers from 20 000 to 200 000. By E. Sang. Pp. xviii+365. (London: C. and E. Layton.) 21*s.* net.

Department of Commerce. U.S. Coast and Geodetic Survey. Geodesy. Application of the Theory of Least Squares to the Adjustment of Triangulation. By O. S. Adams. Pp. 220. (Washington: Government Printing Office.)

State of Connecticut. Public Document No. 24. Thirty-eighth Annual Report of the Connecticut Agricultural Experiment Station, 1914. Pp. xiv+448. (Hartford, Conn.)

The Endocrine Organs: an Introduction to the Study of Internal Secretion. By Sir E. A. Schäfer. (London: Longmans and Co.) 10*s.* 6*d.* net.

Scientific Papers. By Sir G. H. Darwin. Vol. v., Supplementary Volume containing Biographical Memoirs. By Sir Francis Darwin and Prof. E. W. Brown. Lectures on Hill's Lunar Theory, etc. Edited by F. J. M. Stratton and J. Jackson. Pp. lv+81. (Cambridge: At the University Press.) 6*s.* net.

Elements of Mineralogy. By F. Rutley. Revised by H. H. Read. Nineteenth edition. Pp. xxii+394. (London: T. Murby and Co.) 3*s.* 6*d.* net.

The Tribes and Castes of the Central Provinces of India. By C. V. Russell, assisted by Rai Bahadur Hīra Lāl. Four vols. Vol. i., pp. xxv+426. Vol. ii., pp. xi+540. Vol. iii., pp. xi+589. Vol. iv., pp. xi+608. (London: Macmillan and Co., Ltd.) 42*s.* net.

The Homeland Handbooks. Penzance and the Land's End District. Edited by J. B. Cornish and J. A. D. Bridger. Pp. 123. (London: Homeland Association, Ltd.) 6*d.* net.

Manuals of Chemical Technology. vi., The Salt and Alkali Industry, including Potassium Salts and the Stassfurt Industry. By Dr. G. Martin, S. Smith, and F. Milsom. Pp. viii+100. (London: Crosby Lockwood and Son.) 7*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 2.

ROYAL SOCIETY, at 4.30.—The Antiseptic Action of Substances of the Chloramine Group: J. B. Cohen, H. D. Dakin, M. Daufresne and J. Kenyon.—The Structure of the Dicynodont Skull: I. J. B. Sollas and Prof. W. J. Sollas.—Analyses of Agricultural Yield. Part III. The Influence of Natural Environmental Factors upon the yield of Egyptian Cotton: W. L. Balls.—The Function of Chlorophyll, Carotin and Xanthophyll: A. J. Ewart.

ROYAL INSTITUTION, at 3.—Recent Excavations in Mesopotamia—The Northern Capitals, Nineveh and Asshur: Prof. L. W. King.

CHILD STUDY SOCIETY, at 6.—The Danish Child at School: A. E. Hayes.

LINNEAN SOCIETY, at 5.—Exhibit of *Giardia* (*Lamblia*) *intestinalis* from cases of Diarrhœa in Soldiers, the Infections being contracted in Flanders: Dr Annie Porter.—Larval and Post-Larval Stages of *Jasus lalandii*: Dr. J. D. F. Gilchrist.—The August Heleoplankton of some North Worcestershire Pools: B. Millard Griffiths.—The Distribution of the Box-tree, *Buxus sempervirens*: Dr. Otto Stapf.

FRIDAY, MARCH 3.

ROYAL INSTITUTION, at 5.30.—Corona and other Forms of Electric Discharge: Prof. S. P. Thompson.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Oil-fields of Trinidad: V. C. Illing.

MONDAY, MARCH 6.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Some little-known Polynesian Settlements near the Solomon Islands: Charles M. Woodford.

ARISTOTELIAN SOCIETY, at 8.—Sense-Data and the Physical Object: Prof. T. Percy Nunn.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

SOCIETY OF ENGINEERS, at 5.30.—Sewage and its Precipitation: R. Brown.

TUESDAY, MARCH 7.

ROYAL INSTITUTION, at 3.—The Plant and the Soil—Man's Control: Dr. E. J. Russell.

ZOOLOGICAL SOCIETY, at 5.30.—Kinematographs of African Animals: H. K. Eustace.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Industrial Development: Harold Cox.

RÖNTGEN SOCIETY, at 8.15.—*Adjourned Discussion*: The Injurious Effects produced by X-rays.—The Use of Inverse Current: A. C. Gunstone.

WEDNESDAY, MARCH 8.

GEOLOGICAL SOCIETY, at 5.30.—Fossil Insects from the British Coal Measures: H. Bolton.

ROYAL SOCIETY OF ARTS, at 4.30.—Optical Appliances in Warfare: C. R. Darling.

THURSDAY, MARCH 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Distribution of Intensity in Broadened Spectrum Lines: Prof. J. W. Nicholson and T. R. Merton.—Prof. Joly's Method of avoiding Collision at Sea: Prof. H. C. Plummer.

ROYAL INSTITUTION, at 3.—Recent Excavations in Mesopotamia—The Southern Capital, Babylon: Prof. L. W. King.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Continuous-current Railway Motors: E. V. Pannell.

OPTICAL SOCIETY, at 8.—A Simple Focometer for the Determination of Short Focal Lengths both Negative and Positive: T. F. Connolly.—The Manufacture and Testing of Prismatic and other Compasses: F. E. Smith.

FRIDAY, MARCH 10.

ROYAL INSTITUTION, at 5.30.—Illusions of the Upper Air: Sir Napier Shaw.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

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THURSDAY, MARCH 9, 1916.

HISTORY OF CHEMISTRY.

Historical Introduction to Chemistry. By Prof. T. M. Lowry. Pp. xv+581. (London: Macmillan and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.

THE history of a physical science like chemistry differs fundamentally from general history inasmuch as in the former, speaking broadly, men create the epochs, whereas in the latter epochs make the men. When we take a retrospective view of the progress of chemistry we see that its development is, in the main, irregular and spasmodic. Although there are no periods of actual retrogression, except possibly the one that followed the burning of the Alexandrine libraries, there are periods of comparative stagnation interrupted by sudden breaks, so to say, in the curve of its continuity. These breaks mark epochs of new departure, arising from discoveries, frequently wholly unexpected and often revolutionary in character, and nearly always due to individuals working independently of their fellows, and not consciously influenced by any *Zeitgeist*.

On the other hand, in political, economic, or sociological history, we are usually able to trace a general movement in communities, or of powerful groups of society, or of definite interests, and the more or less gradual and progressive working of a popular sentiment which is ultimately given practical effect to by the leader or statesman of sufficient perspicacity to read aright the signs of the times.

Hence, on account of this essential difference, the history of chemistry is necessarily to a large extent the history of its leading men—that is, of the pioneers whose work constitutes those new departures which make up the successive epochs in its progress.

This difference between the leaders in science and in politics, it may be noted in passing, is not sufficiently recognised by the community. The successful political leader in these democratic days in reality seldom leads: he follows, and is directed by the popular will; and his success as a practical politician depends upon his astuteness in divining the psychological moment in which to give effect to that will. The leaders in science—the Boyles, Newtons, Davys, Faradays, Daltons—are in no wise controlled or influenced by any analogous movement on the part of a community. They pursue their investigations and make their discoveries independently of any prescribed demand. In this sense they are real leaders, and by their own independent action impose such natural laws as they may be able to promulgate.

It is, of course, possible to teach the historical development of chemistry impersonally, and doubtless this is the more rational method. But it offers far more difficulties than the other, and from the point of view of the ordinary student is probably less instructive, as it is certainly far less interesting. In the book before us something in the nature of a compromise has been attempted between the impersonal and the purely biographical methods, but, as frequently happens in compromises, the result is not wholly successful. The author states that he has made no attempt to write a formal history of chemistry either of its various periods, or of the biographical stories of its pioneers. His method is to take certain substances, or groups of substances, such as the Acids; Chalk, Lime, and the Alkalis; Muriatic Acid and Chlorine; Inflammable Gases, etc., distributed over about a dozen chapters, and in the remaining eight chapters of the twenty chapters constituting the book to deal with certain theoretical conceptions of the science, *e.g.* the Atomic and Molecular Theories; Molecular Architecture; Classification; Balanced Actions, etc. As regards the first section it is not obvious why the particular selection or its particular sequence was adopted. It may be that the merit of any particular selection is largely a matter of opinion; or possibly the author may think that selection is the best which in his judgment enables him to group the largest number of historical facts in something approaching to chronological order.

Each chapter is split up into sections, designated as A, B, C, D, etc., with corresponding sub-headings, and it concludes with a summary and supplement. The object of the supplement, apparently, is to deal with statements that had been omitted from the main body of the chapter, or which for some reason or other could not be conveniently treated in their proper place. In many cases the supplements consist almost wholly of elementary chemical equations in explanation of chemical changes referred to in the text. As these are expressed by up-to-date conventions it may have occurred to the author that their very modernity would be as incongruous as the absurd anachronisms which he rightly condemns, such as the substitution of the bunsen burner for the big spirit lamp in illustrations of Dumas's apparatus for determining the gravimetric composition of water; or in the picture of Lavoisier's red-hot gun-barrel, in which rubber corks take the place of clay-joints.

But whatever may be the reasons which in-

duced the author to adopt his particular treatment, the effect is to give his work a somewhat disjointed structure. The treatment is slight and "sketchy," and at times inadequate. It is irrational, for example, to dismiss the work of twenty centuries in about as many lines, but this is practically all the space that is given to ancient and alchemistic chemistry. To say that the study of chemistry begins with the work of Boyle is on a par with Wurtz's famous statement that it owes its origin to Lavoisier, and is equally untrue.

Dr. Lowry's book, in spite of occasional slipshod writing, is interesting reading, and the student, if already furnished with a little chemical knowledge, will pick up much information concerning certain broad features in the development of the science since the middle of the eighteenth century. The illustrations of classical apparatus are a valuable feature, although we are unable to see the relevancy of the pictures of crystallised minerals and salts taken from the national collections in the British Museum. They are like the tropes and metaphors which King James deprecated in the sermon—"brilliant wild flowers in the field of corn, very pretty, but of no particular advantage to the corn."

RELATIVITY AND ELECTRONS.

Relativity and the Electron Theory. By E. Cunningham. Pp. vii+96. (London: Longmans, Green and Co., 1915.) Price 4*s.* net.

THE principle of relativity has gradually acquired a fundamental position in theoretical physics, and the appearance of an introductory monograph on the subject will be welcomed by all who wish to have a knowledge of its essentials. The present work, as stated in the preface, is written with the purpose of setting out as clearly as possible the relation of the principle to the generally accepted electron theory. Only quite elementary mathematical analysis is employed throughout the book; those who wish to penetrate more deeply in the subject being referred to the author's larger work on "The Principle of Relativity."

In the latter part of the book the principle of relativity is presented from Minkowski's point of view. The four-dimensional form of relativity is of very great importance, partly on account of its elegance and simplicity, but also because of its suggestiveness in the present transition stage of dynamics. Unfortunately, only a short outline of the four-dimensional vector analysis of Minkowski and his disciples is given. On p. 72 examples of 4-vectors are given in a form which is open to criticism. The point-instant (x, y, z, t) is called a 4-vector. It would be more satisfactory to denote the 4-vector by (x, y, z, ict), since ict and not t is actually the fourth component of the vector in question. A similar remark applies to $\kappa(u_x, u_y, u_z, 1)$ (on the same page), which should be written $\kappa(u_x, u_y, u_z, ic)$, in which form it would be consistent with the equation at the foot of p. 75, viz.:

$$(S_x, S_y, S_z, S_u) = \rho(U_x, U_y, U_z, ic)/c.$$

The quantity denoted by "κ" is, in consequence of a printer's omission, imperfectly defined. The author introduces four-dimensional vectors in the "New Mechanics" in an excellent way by showing how they serve to unify the two aspects of "force" as the "time rate of change of momentum" (Galileo) and "space rate of change of energy" (Huygens). One of the characteristic features of Minkowski's presentation of the principle of relativity is its capacity for unifying or reconciling different and, in some cases, apparently contradictory aspects of phenomena.

In the final chapter the author outlines the way in which the "objections of those who demand a *real* æther to carry *real* effects" can be met.

The work is one of considerable merit, and provides a really good and sound introduction to the subject with which it deals. W. W.

THE HANDWORKING OF IRON AND STEEL.

Forging of Iron and Steel. By W. A. Richards. Pp. viii+219. (London: Constable and Co., Ltd., 1915.) Price 6*s.* 6*d.* net.

THE title of the above work is somewhat misleading, in that its scope is much narrower than is suggested by the title. Apart from a short chapter at the end on steam and power hammers, it deals only with hand-forging in its various aspects. The book, which is stated to be intended both for the "high-school boy" and the "veteran smith"—it is written by an American—opens with a chapter on the historic use of iron and steel from early periods. It then deals in brief review with the smelting of iron ores and the production of cast irons, wrought irons, and steels, the author stating that it is unnecessary to go deeply into the subject of metallurgy or to introduce metallurgical theory. We are told (on page 20) that the air pressure in the blast furnace is from 15 to 25 lb. per square inch. No doubt in the hard-driven American furnaces, where

everything is sacrificed to output, the blast pressures are higher than in this country, where they seldom exceed from 8 to 9 lb. per square inch, but the above figures are certainly higher than the highest we had associated with American practice. They throw light, however, on the performance of an American blast furnace erected in Middlesbrough some years ago which was worked by American engineers, and which blew so much iron ore out of the top of the furnace that it was put, and has remained, on the low pressures that are found to be suitable in English practice.

A few pages later we are informed that the temperature of the cementation furnace in the production of blister steel—a process in which the iron is never melted—is about 3000° F. This corresponds to 1650° C., which is nearly 150° C. above the melting point of iron. The author makes several unsuccessful attempts to spell the name "Siemens," the inventor of the open-hearth furnace. Sometimes he calls him Sieman; at others Siemans. On the whole, it is as well that he does not introduce metallurgical theory.

Chapters on equipment and fuel are followed by four others dealing with the various operations involved in hand forging. These are succeeded by two on welding and one on brazing. The remainder of the book is given up to the manufacture and treatment of the various kinds of tool steels, together with short chapters on art ironwork and calculations. At the end of each chapter are appended questions for review, of which the following is a fair specimen:—"What is carbon steel? What is air-hardening steel? What is high-speed steel? Tell how each differs. Tell how to harden and temper tools made from high-speed steel. Describe the working of high-speed steel in the forge fire. Describe the annealing of high-speed steel. Describe the grinding of high-speed steel." The chapter containing the information from which the foregoing questions are to be answered is less than four pages in length.

The author states that the methods described in his book have been "thoroughly tried out during ten years of experience in teaching and supervising manual training." His book therefore should contain much that is of value to those who are interested in such methods. We think, however—largely no doubt owing to the way in which it has been written—that it will appeal more to American than English readers, and chiefly because elementary education in this country, in spite of its shortcomings, is better than in America.

H. C. H. C.

OUR BOOKSHELF.

A Plea for an Orderly Almanac. By A. Philip. Pp. 62. (Brechin: *Advertiser* Office, D. H. Edwards, 1915.) Price 1*s*. net.

The author indicates some minor changes that might be carried out without altering the existing calendar. He points out the inconveniences that arise from the present plan of arranging fixtures for (say) the "third Wednesday of the month." Such fixtures do not come in a regular order; the second Tuesday may either precede or follow the second Wednesday. This system offers little facility for adjusting dates so as to fit each other with a minimum of clashing.

The remedy proposed is to take the "trimestre," or three-monthly period, as our unit instead of the month. Each trimestre must contain twelve complete weeks from Sunday to Saturday, with odd days at the beginning, end, or both. If fixtures are arranged for definite days of these twelve weeks, their relative order is invariable, and the list can be prepared, once for all, so as to secure the maximum convenience. It is suggested that the trimestres should be: (i) March, April, May (92 days); (ii) June, July, August (92 days); (iii) September, October, November (91 days); (iv) December, January, February (90 or 91 days). These practically coincide with the four seasons, and the placing of the leap day at the end reduces its inconvenience to a minimum. In fact, the device of counting from March 1 is not new to astronomers, some tables having been drawn up on these lines.

The author points out a decided convenience that would result from beginning our national financial year on March 1, instead of April 1. It would avoid the anomaly that the financial year may contain two, one, or no Easters. The effect of these variations on the national income is quite appreciable, and has been pointed out in the House of Commons. He gives some suggestions for adapting wages, weekly insurance payments, and old age pensions to his scheme, and appends tables showing the incidence of his twelve-week periods up to the end of 1919.

A. C. D. CROMMELIN.

Flora of the Presidency of Madras. By J. S. Gamble. Part i. *Ranunculaceae to Aquifoliaceae.* Pp. 200. (London: West, Newman and Co. and Adlard and Son, 1915.) Price 8*s*. net.

In the review of Prof. Fyson's "Flora of the Nilgiri and Pulney Hill-tops" in NATURE for February 3, an account is given of the general scheme for local Indian floras. The "Flora of the Presidency of Madras" has now to be added to their number, the first part having been published at the end of January.

The "Flora" is being prepared by Mr. J. S. Gamble, late of the Indian Forest Department, well known for his book on Indian timbers, and is a model of what such a local flora should be. This

first part consists of 200 pages, comprising the families Ranunculaceæ to Aquifoliaceæ, but, unfortunately, we have to wait for the concluding part of the work for the appearance of the introduction and key to the families. Without these the "Flora" loses some of its value and much of its interest, and it is to be hoped that the publication of the succeeding parts will take place as rapidly as may be possible.

The plan followed in the "Flora" is that adopted by Prain in his "Bengal Plants," and is a plan admirably suited for a local flora where the easy identification of the plant is the object in view. Descriptions of species are therefore omitted, and the whole flora is in the form of key. A description of the natural family is succeeded by a key to its genera. Each genus is concisely described, and a key to its species follows, and then under each species there is no further descriptive matter, but only geographical and economic information and vernacular names. In those genera represented by only a single species, a short description is given. The keys are well drawn up, and a good test of their efficacy is to be seen in the genus Impatiens with its seventy species, which are all clearly differentiated. It should be mentioned that Mr. Gamble was assisted by Mr. S. T. Dunn in the preparation of about the first 132 pages of this part.

The Theory of Abstract Ethics. By T. Whittaker. Pp. viii + 126. (Cambridge: At the University Press, 1916.) Price 4*s.* 6*d.* net.

THIS book is the result of stimulus applied, as the author informs us, by Prof. Juvalta's "Old and New Problem of Morality." Though awakened from dogmatic slumber by Renouvier, Mr. Whittaker had continued, in accordance with English tradition, to try to derive the ethical law of justice from "ends" or "goods." But the *a priori* cannot be avoided; and if a metaphysical doctrine emerges that is more in harmony with the moral aspirations of mankind, we must not refuse to consider it out of a forced austerity.

The fundamentals of every moral system are liberty and justice; and abstract ethics, as distinguished from the art of life in general, is a kind of impersonal science of the conditions under which all the types are bound to live in common. In the present state of affairs, however, the author naturally expatiates into concrete ethics and politics, giving a useful summary of Kant's view. The moral law recognised within states should be extended to their mutual relations, with the aim of eternal peace, which will be possible when we have progressed to a permanently superior political society. But he did not postulate a world-state so much as a family of states each respecting each other's individuality. Finally, on the last page, the author permits himself a legitimate speculation, perhaps too friendly, in the direction of reincarnation, which is certainly one feasible way of resolving many moral problems.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Method of Curves.

THE expression of the results of observations and experiments by curves became common during the first half of the nineteenth century. One of the first instances was given by Perkins (*Phil. Trans.*, 1826) in a paper on the compressibility of water.

Six years later Sir John Herschel (Trans. Ast. Soc., v., 1) gave an account of the method of graphical construction on squared paper as applicable to astronomical computations and physico-mathematical inquiries.

"The dates in years and decimals are measured as abscissæ, and the angles in degrees and decimals as ordinates. The next step is to draw by the mere judgment of the eye, and with a free but careful hand, not through but among the points, a curve presenting as few and slight departures from them as possible, consistently with the character of large and graceful sinuosity, which must be maintained at all hazards.

"But since an equal trustworthiness can probably not be placed on all the observations, we must take care to distinguish those points which correspond to observations entitled to the greatest confidence, such as those which appear to have been made under peculiarly favourable circumstances, or which rest upon the average of a very great number of individual measurements. These should be marked on the chart in some special manner not liable to be mistaken, and when we draw the curve we must take care to make it pass either through or very near all those points which are thus distinguished; or at least to deviate from them with much more reluctance than from such as have no claim to our peculiar attention.

"By substituting the curve for the points we have made a nearer approach to nature, and in a great measure eliminated errors of observation."

A few years later Regnault (Mem. Acad. Sci., 1847, xxi., p. 316) reduced the method to a fine art. To represent the expansion of mercury he used four copper sheets, 80 cm. square, each divided into 10,000 squares. Within these squares values were marked by a special dividing engine, one bevelled edge of the heavy base of which was graduated into 8 mm. divisions and tenths. A carriage running on a half-millimetre screw, the large head of which was divided into 50, so that 0·01 mm. could be accurately measured, carried the burin. Experimental values were marked by the intersections of lines drawn by the burin. A free curve was drawn by Regnault, which was completed and engraved by an artist. Even with these precautions a constant error was detected in the last plate.

The introduction of the copper plate and dividing engine seems to conduce to the accuracy and permanence of the record.

The method has been rendered more easy of application and possibly more accurate by the introduction of mechanically ruled paper, a good sample of which of French manufacture consists of sheets a metre square, ruled into millimetre squares, each edge of which is divided into 0·2 mm. by dots. Free hand-curves have also been more or less replaced by mechanically cut curves and flexible laths.

Notwithstanding the very general use of the method and many theoretical accounts of it (Whewell, "Nov. Org. Ren.," 1858, p. 204; Stanley Jevons, "Principles

of Science," 1877, p. 492), culminating in the admirable reports of Prof. Hele-Shaw (B.A., 188–92) "On Graphic Methods in Mechanical Science," there still seem to be many doubtful points in the theory and practice of the process; much valuable information has never been published, and is confined to individual workers, while the few attempts which have been made to estimate the accuracy attainable have given widely different results.

The following questions seem to present themselves among others for consideration.

What is the best material for a diagram sheet?

Mechanically ruled paper is by far the most generally used, but it is not very permanent and is apt to be injured by the points of measuring instruments. Possibly the best material would be ordinary, white, or blue glass, which alters very little with time, has a low coefficient of linear expansion, $<0{\cdot}000\,009$, and is not easily scratched. The requisite lines could be marked by a diamond, carborundum wheel, or special ink; or the whole plate might be varnished, the lines then drawn on the varnish and etched in.

Does the colour of the sheet or ink make any difference in the accuracy or ease of the work?

Babbage found that black on green conduces to ease and accuracy in the use of tables. Chocolate on white is said to be more legible than black on white.

Is it more advantageous to work with lines as fine as consistent with visibility, or always to the same edge of thicker and more visible lines?

Is there a limit of size, say, about a square metre, beyond which increase in size does not conduce to accuracy?

What is the best method of measuring lengths on diagrams? What is the effect of time and damp on paper sheets and of change of temperature on metallic ones?

A difference of 10° C. in the temperature of the room would alter the length of a copper sheet by 0·00017, but this is corrected by using the sheet as the measuring instrument.

What is the best form of lath? Wood, steel, or steel backed by lead? How should the lath be held or pinned?

In what cases are other forms of ruling, such as semi-logarithmic, logarithmic, triangular, or circular, advantageous?

By general consent the curve selected should show as few changes of curvature as possible consistently with passing through or near the great majority of the experimental points and lying fairly among them. Suppose one or more points lie at a considerable distance from the curve—is this due to experimental error and to be therefore neglected?—to a rapid but continuous change in the condition of the substance under examination, to be represented by a change of curvature, or to a change in the nature of the substance to be represented by a break and a new curve?

The answer to these questions depends upon the estimate which the experimenter forms of the "error" of his experiments. One may consider his error as large, and prefer a simple curve which does not represent his results very exactly; another may deem his error less, and prefer a more complicated curve passing more nearly among the experimental points; a third may consider that his error is very small, and that his results are best expressed by two or more simple curves, and hence assume a very fundamental change in the nature of the substance.

In very accurate work, then, the experimenter is more or less obliged to estimate or determine the error of his observations, and much has been written on methods for the purpose. Most experimenters seem not to repeat their experiments several times under as nearly as possible the same conditions, without which no determination of the error is possible, but trust to subsequent correction by the curve. The "probable error" is generally the most convenient; it may be obtained from a considerable number (n) of observations upon a single quantity by finding the residuals (v), that is, the excess or defect of each observation from the arithmetical mean, adding the squares of the residuals together, dividing the sum of the squares by $n\ (n-1)$, and multiplying the square root by 0·67449, or $p.e. = 0{\cdot}67449\sqrt{\Sigma v^2/n(n-1)}$.

The estimates of the accuracy attainable are, as might be expected, very various. It is stated (J.S.C.I., xxii., 1227) that a density determination, such as that of dilute nitric acid, can be carried to 1 part in 75,000, and this claim is moderate.

On the other hand, it is curious to find (Clarke's Tables, 298) that the results for the density of chloroform found by a great recent experimenter at two different temperatures each differ by about 1 part in 2500.

It is perhaps not so generally recognised that the graphical method itself introduces a fresh series of errors which may be quite comparable in magnitude with, or even greater than, those incidental to careful experiments.

Every graphical reduction comprises five operations, each liable to error—measurement of the abscissæ, measurement of the ordinates, drawing the curve, measurement of the abscissa, and of the ordinate of the new value required. Hele-Shaw remarks that the results given by the use of graphical methods cannot be regarded as very accurate, and quotes Poncelet and Culmann:—"The constructing engineer will give preference to geometrical solutions whenever an accuracy of results up to three decimals (one-thousandth), which can be perfectly well obtained, is sufficient." By mechanical engineers about 1/2000 seems to be considered the limit of accuracy. To take the simple case of ordinary rectangular co-ordinates, the draftsman depends upon the accuracy of the machine ruling. Suppose an ordinate is 1′ out of the perpendicular, the measured abscissa is too long or too short by 1/3400 of the length of the ordinate.

It is extremely difficult to make a valid estimate of the error introduced by a graphical reduction, depending as it does upon individual eyesight and hands. Good eyes can distinguish a tenth of a millimetre between two points, but age, accompanied as it too often is by astigmatism, may much impair this estimate.

Stanley Jevons attempted to find the value of π by the careful use of compasses; he did not come nearer than 1/540. He does not mention which of the numerous approximate constructions he used.

To obtain the probable error of the experiments and reduction, the square root of the sum of the squares of the separate sets of residuals must be taken.

The adequate estimation of the errors, both of the results and the reduction, becomes of still greater importance when it is attempted to establish breaks in the curve and discontinuity in the results by obtaining differential coefficients from the equation to the curve, by plotting differences, or by mechanical means (Proc. R.S.E., May, 1904). It must also be remembered that each of these processes introduces a new series of errors of its own, and may apparently increase the original errors, which are more or less removed by the first curve.

Each experimental result is represented by a point, and however much the scale of the diagram is enlarged these points remain points, and may give a false appearance of accuracy. In very accurate work would it not be worth while to extend Herschel's

suggestion and determine the probable error of each experimental result? Each result could then be expressed by a circle the radius of which is equal to half the probable error, and which would increase with the size of the diagram. If another experiment be made under similar conditions it is about an equal chance that it falls within or without the circle, which therefore affords a measure of the precision of the observations. Since there is little evidence against any curve which cuts the circle, the variations in size might profoundly modify the opinion of the draftsman as to the direction of his curve.

SYDNEY LUPTON.

Ground Rainbows.

I HAVE seen with pleasure Mr. Heath's clear and instructive letter and diagrams on this subject in NATURE of March 2. Some fourteen years ago I calculated the altitudes of the sun required to produce the elliptic and other arcs, and obtained results in agreement with Mr. Heath's, except that I took 41° instead of 42° for the semi-angle of the cone.

For Petersfield, at 11 a.m. on October 14, 1915, the sun's altitude, 23°, appears to be somewhat underestimated, and I make it just above 30°, but this, of course, leaves the bow still hyperbolic.

I was led to consideration of the curves for the ground rainbow when seeking for a reason why the sky rainbow is seen always circular, though, when the sun is not on the horizon, the bow might perhaps have been expected to appear elliptical, the circle being projected into an ellipse on a plane perpendicular to a sight-line, assumed horizontal.

I came to the conclusion that, there being no definite plane of reference in the sky, and the rays being parallel, there is, as it were, no element of definite distance involved, so that the sky bow always appears circular. But for the ground bow we have a definite horizontal plane of reference, so that this bow becomes a conic section, varying with the sun's altitude.

I had some interesting correspondence at the time with the late Sir G. G. Stokes, and I may perhaps quote from one of his letters, dated August 22, 1902, only six months before his death. Replying to my question as to whether a dew bow is seen as a circle or an ellipse, he wrote :—

"It is a question of the combination of sensation and expectation. In a dew bow we are impressed with the idea that the luminosity we see is spread over a horizontal plane; and we tacitly ask ourselves the question : What must be the actual form of the locus of the drops on the grass in order that the luminosity may appear as it does? The answer, of course, is, an ellipse, or it might be an hyperbola. If the question be : As what do we see the bow? the answer depends on a combination of sensation with interpretation of sensation. If we merely saw the luminosity, and knew absolutely nothing about its history, we should never think of anything but circularity about it."

I have often looked for a ground bow, but have never been fortunate enough to see one.

Observing a fine lunar rainbow on January 21, I found the light to be polarised in planes passing through the point looked at and the radius at the point, just as is the case with the solar rainbow. I hope that Mr. Heath will test the next ground bow with a Nicol prism.

C. T. WHITMELL.

Invermay, Hyde Park, Leeds, March 3.

IN the Proceedings of the Royal Society of Edinburgh, vol. vii. (1869–70) Clerk Maxwell has a short note on a bow seen on the surface of ice. This was observed on January 26, 1870, on the frozen surface of the ditch which surrounds St. John's College, Cambridge. Maxwell remarks, "How a drop of water can lie upon ice without wetting it and losing its shape altogether I cannot profess to explain." In 1898, in vol. xxii. of the same Proceedings (1898) there is a note on dew bows by Dr. R. A. Lundie and myself. These were produced at night on the ground, the source of light being the gas lamp or electric light of the street. A short account will be found in NATURE of January 12, 1899 (vol. lix., p. 263).

C. G. KNOTT.

Royal Society, Edinburgh, March 4.

Science and the State.

REFERRING to Prof. Cohen's letter in NATURE of March 2, it may not be untimely to cite another paragraph written in 1831 *re* neglect of science in this country. Sir David Brewster, in his "Life of Newton," published in that year, says :—

"But what avails the enthusiasm and efforts of individual minds in the intellectual rivalry of nations? When the proud science of England pines in obscurity, blighted by the absence of the royal favour, and of the nation's sympathy—when its chivalry fall unwept and unhonoured—how can it sustain the conflict against the honoured and marshalled genius of foreign lands?"

The position to-day is fortunately not quite so bad as here indicated by Brewster, but is it not still the case that, in the words of Sir Archibald Geikie, science rests under an incubus of apathy and indifference? Expansion of science and national evolution are two matters that in the opinion of the writer are intimately bound up one with the other. Neglect of the former really means inhibition of political progress.

DAVID BALSILLIE.

Greyfriars Garden, St. Andrews, March 4.

THE NATIONAL IMPORTANCE OF THE DYE INDUSTRY.

AT the annual meeting of the Bradford Dyers' Association held on February 28 the chairman of the directors, Mr. Milton S. Sharp, made a highly interesting statement on the national position with regard to the supply of dyes. He described with great force and clearness the close connection between the manufacture of dyes and high explosives, and pointed out how Germany by reason of her huge, highly organised, and ably administered colour works, producing all the raw materials for the making of high explosives, was able immediately to divert much of their plant to war purposes. He paid a high tribute to Lord Moulton and the High Explosives Department for their services, the value of which, he said, the country will probably never know, in improvising the manufacture of high explosives. He urged that whatever it involves, we must establish the aniline dye industry in this country, so that in case of war we may have the ability to produce quickly any amount of high explosives the Army or Navy may need. The extensions of plant that have been made for the temporary purpose of manufacturing high explosives will, he says, make a long and essential step towards the colour industry, and to break them up after the war would be little short of criminal folly. Mr. Sharp quoted some effective examples of German activity in relation to the chemical service of the war. He alluded to one

colour works with 14,000 men, and another with 9000, now engaged wholly in the manufacture of high explosives; to the fact that 75 per cent. of the German collieries have coke ovens installed; to the synthetic production of 200,000 tons per annum of ammonia, and the conversion of ammonia into nitric acid.

Great praise was given by Mr. Sharp to the efforts of the older dye-makers in this country and to the new British Dyes (Limited) for their efforts to augment the supply of dyes, and of the Swiss makers he said that he dare not contemplate what our position would have been during the last eighteen months without their aid. Alluding to the desirability of greater sympathy and closer co-operation between dye-users and dye-makers, he quoted the example of a firm with which the Bradford Dyers' Association had been in close association, and with which shortly before the war they had placed a contract for 1000 tons of a colour previously obtained from the only maker in Germany.

The general and fiscal policy urged by the directors of the Bradford Dyers is the appropriation by Government for a term of years of a grant-in-aid of 500,000*l.*, to be administered by a commission charged with the duty of securing the establishment of the industry in this country by grants on production and for enterprise and initiative. Such a commission, they think, with enterprising, energetic, and fearless leadership, would secure the establishment of the industry in this country, not only on less debatable lines, but also much more quickly than by import duties. In the absence of import duties, however, it is thought essential to have most stringent provisions to prevent dumping. Whether import duties are imposed or not, the directors feel that special and extraordinary aid is needed, and they believe that such a commission would make the removal of dependence on Germany more certain than could possibly be hoped for by leaving British colour-makers to their own unaided and unco-ordinated efforts.

Mr. Sharp's speech is a weighty utterance, remarkable for the clear perception of the grave national and scientific implications of the dye question; and such pronouncements from our leading industrialists cannot be over-valued for their influence in giving to the public a just perspective.

WOOD PULPS FOR PAPER-MAKING.

IN the revision of values, moral and material, which is imposed upon us under the present awakening to a new order of realities, it is recognised that we have to create in and for the empire a definitive industrial science, and a co-ordinated scientific industry. To contribute to this effectually, science has to concentrate the trained mind upon manufactures, so as to grapple with its problems by scientific method, which is quantitative *qua* matter and energy, and comprehensive *qua* the moral and political factors of production. Manufacturers and business men have the more difficult task of undertaking a whole-hearted study of science so as at least to arrive at a clear grasp of what this comprehensive term connotes in the creative influences of the old order, and the potential directing genius of the new. Both parties to the new order would be thus reciprocally enlightened as a necessary preparation for earnest co-operation.

In either direction of inquiry it is necessary to set out from clear perspectives of related values, and it is self-evident that those of the natural order claim first attention. Thus, in the organic world, cellulose, starch, and sugar represent primary values of preponderating importance. The industries based upon cellulose, starch, and sugar: their production by agriculture, their transformation by mechanical and chemical means into the derived forms in which they are actually used, together with the countless dependent industries of which these derivatives are in turn but the raw materials, constitute an industrial aggregate which represents, say, one-half of the productive energy of the community. An unprejudiced view of the wider relations of these industries would also recognise that Great Britain has well maintained a premier position in their more important sections, as well as in their later and more definitely scientific developments.

This result is due to ordinary scientific, technical, and business enterprise, and the activity of individual pioneers, not to any conscious or co-ordinated movement towards preposed objectives. More particularly is this true of the cellulose industries, which comprise colossal textile manufactures: paper-making, and such special manufactures as nitrocellulose and high explosives, celluloid, and artificial silk; the latter, which is the youngest—in fact a twentieth-century product—rapidly growing from an *article de luxe* to the position of a staple textile.

There is one feature of these industries which marks them for special consideration in relation to the new order to which the civilised world is shaping or being shaped; that is, their almost complete dependence upon exotic raw materials. In the new order of co-ordinated industrial objectives how are we to deal with the present condition of dependence for essential raw materials?

This is much too vast a question to be discussed within the necessary limits of the present article. We must be satisfied to treat a single typical case: and we select the paper-making industry. The modern expansion of this industry in Great Britain has been conditioned by the discovery of new forms of raw material, chiefly of esparto grass (1861), and the wood pulps (1880).

The importation of esparto in the period 1861–1883 steadily increased to 200,000 tons, at which figure it remains constant, with a variation of 5000 tons. The wood pulps, on the other hand, show a uniform progressive increase, and in 1913 the figures reached:—

	Tons
"Chemical" pulps, *i.e.*, wood celluloses	400,000
"Mechanical" pulps, *i.e.*, ground wood	280,000

The technical and commercial points represented in these figures are as follows:—(1) the enormously increased production of paper has been *mainly* conditioned by the utilisation of wood pulps; (2) esparto rapidly displaced rags in the production of printing and writing papers: it established new qualities in papers of this class, producing very fine printing surface with "bulk." (3) The wood pulps (celluloses) were adopted not only on their quality or merits, *as celluloses*, but being obtained from a massive material, they were produced in a state of exceptional cleanliness, and by economical processes.

Moreover, the paper-maker found himself provided with a half-stuff, clean, cheap, and in presumably unlimited quantities. It will be appreciated that a "half-stuff" is half-manufactured stuff, and its introduction displaces the chemical pulping of actual raw material. Hence, a progressive and two-fold dependence of our paper mills upon exotic supplies. This point is very clearly emphasised by the statistics of the census of production.

In the censal year (1907) the gross output of our paper-mills was in value 13,621,000*l.*

In that year we imported:—

	Tons	£
Wood pulps: chemical and mechanical	672,500 ...	3,312,347
Esparto	202,253 ...	738,834

This represented about 80 per cent. of the total of raw materials consumed. We imported of fully manufactured products, *i.e.*, papers and boards, to the value of 5,362,000*l.*, so that our home production was 70 per cent. of our consumption.

The rate of increase of our importation of raw materials will be seen by comparison with the subjoined figures for 1912.

	£
Esparto	743,354
Wood pulp { chemical	3,200,000
Wood pulp { mechanical	1,220,000
Linen and cotton rags	312,351
Miscellaneous	318,700
Total	5,794,405

The wood pulps thus representing 70–80 per cent. of the raw material for this important industry, the question arises, Can we advantageously produce this quantity within the empire? That we have a sufficiency of forest area there can be no doubt. In his estimates of the forest areas of the world, Schlich assigns to Canada 800 millions of acres, whereas Germany, which may be regarded as self-contained in regard to wood-pulp production, has a forest area of only 35,000,000 acres.

It may be interesting to state the average required to supply pulp for producing 300 tons per week of newspaper. This is generally estimated at 2500 acres per annum; a forest area of 100,000 acres would therefore mean a forty years' supply, and as forty years is the period for the spruce to reproduce itself fully in well-matured timber, it is clear that a mill of such dimensions in the centre of this area is a "self-contained proposition."

It is evident that Canada under a system of organised forestry is capable of meeting our full requirements. In further evidence of her productive capabilities it is to be noticed that she is already responsible for about one-sixth of the world's production, as will be seen from the following figures for 1907–1908:—

Annual Production of Wood Pulp for Various Countries, calculated on the Air Dry Basis (1907–1908).

Country	Mechanical pulp Air dry tons	Chemical pulp Air dry tons	Total annual production
Germany ...	315,000 ...	320,000 ...	635,000
Norway ...	421,000 ...	270,000 ...	691,000
Sweden ...	78,000 ...	510,000 ...	588,000
Finland ...	69,000 ...	52,000 ...	121,000
America ...	868,000 ...	988,000 ...	1,856,000
Canada ...	565,000 ...	172,000 ...	737,000
	2,316,000	2,312,000 ...	4,628,000

Under present conditions (1914) there is little exportation of Canadian pulp to Europe, and this small proportion is mechanical pulp.

As to our own islands, the question of afforestation was investigated by a Commission, which published its report in 1909. The Commission concluded that the available area was 9,000,000 acres, which would absorb for development an annual sum of 2,000,000*l.*; in forty years the self-supporting stage is reached. After eighty years the revenue was estimated to reach 17,500,000*l.*, representing $3\frac{3}{4}$ per cent. on the net cost, calculated at compound interest (3 per cent.).

The question of esparto, if raised from this political point of view, is either that of finding substitutes of indigenous origin, *i.e.*, within the empire, or of cultural experiments towards its establishment in selected areas affording similar conditions as obtain in the Mediterranean littoral.

On the former problem, attention should be directed to the work of the Imperial Institute, and the record of its many investigations of potential supplies of paper-making material. In the Journal of the Institute there are many of these reports on fibrous materials; from India, South and East Africa, the Sudan, British West Indies, British Guiana, and the Malay States. If an "Imperial opportunity" is judged to have presented itself in the matter of a supply of these raw materials within the Empire, advantage may well be taken of the excellent work of the Institute.

It is characteristic of our political "method" to leave everything industrial, technical, and scientific to individual enterprise, whether of persons or corporations; and in this region of fibrous raw materials, whether for paper or textiles, we have come through under the old order with some success, and not a few conspicuous successes. In this region, moreover, we owe nothing of moment to "German method," and we are not under any moral pressure to advertise it by reiterated comparisons. But we are conscious of a new order under which we have to co-ordinate our industries. In the small section under consideration much work has been done by individuals and corporations—prophetic individuals and some profit-earning corporations—much material has

accumulated, and it is open to a political pioneer, not necessarily a lawyer, to take in hand a matter which affects immediately an important section of our industrial community—labour and capital.

Should a definite organisation result it would probably be extended to embrace the whole range of vegetable textile materials which we estimate to affect directly the interests of one-third of the working community. C. F. Cross.

PROF. J. W. JUDD, C.B., F.R.S.

Many will regret to hear of the death of Prof. John Wesley Judd on March 3 at his home in Kew, after some months of illness. He was born at Portsmouth on February 18, 1840, but in his eighth year went to London with his father. There he attended a school in Camberwell, and at an early age showed a love for astronomy and geology. When grown up he accepted a mastership in a school at Horncastle, Lincolnshire, where his spare time was devoted to chemistry and geology. In 1863 he became a student at the Royal School of Mines, after which he took the post of analytical chemist in some important iron and steel works in Sheffield. There began, in 1864, his friendship with H. C. Sorby, who imparted to him his newly-devised methods of petrological study, but his work in that city was brought to an end by a railway accident, which for a long time compelled him to abstain from continuous labour, so he resumed his geological studies in Lincolnshire.

In 1867 Judd joined the Geological Survey, and for the next four years was engaged in mapping Rutlandshire, with parts of the adjoining counties. But in 1871 a desire for greater freedom led him to accept an offer of temporary employment in the Education Department, and during this time began his studies of the Wealden deposits. When this work had come to an end, he devoted himself to investigating the Triassic and Jurassic deposits in Scotland and of the igneous rocks so grandly displayed in its western islands. This was a difficult task, owing to the want of good maps and to travel in that part of Scotland being less easy than at the present time. The result was a group of important papers, the first of which appeared in 1873.

These attracted much attention and led to friendships with Charles Lyell, Poulett Scrope, and Charles Darwin, the second of whom commissioned him to carry on an investigation of the volcanic districts of Europe, which he had been obliged to abandon. In April, 1874, Judd visited the Lipari Islands, going on to Vesuvius, the Phlegræan fields, and the adjacent volcanic district. He also studied the Ponza Islands, on which Scrope had published an important paper in 1827, with the great crater lakes of Central Italy, the Euganean Hills, and the volcanic districts of Hungary. After his return to England he was appointed, in 1876, professor at the Royal School of Mines in succession to Sir Andrew Ramsay. He at once began to organise the teaching, but there was not room at Jermyn Street to do this effectively, so his department was soon transferred to South Kensington, and ultimately lodged in galleries which had been constructed for the 1862 Exhibition. There he established a complete system of instruction, which was then unequalled and has never been surpassed in this country, and, in addition to this, his lucidity, patience, and kindness as a teacher secured him a full and attentive classroom. In 1896 he became Dean of the Royal College of Science, and in 1905 retired under the rule of age. It is painful to add that, after accomplishing so great a work, the officials of the Government awarded him a lower pension than he had expected, on a pretext which, if in accordance with the letter of a law, was certainly inequitable.

Judd was elected a fellow of the Geological Society in 1865, was secretary from 1878 to 1886, and president from the latter year until 1888. In 1891 he received the Wollaston medal. He was elected F.R.S. in 1877, and twice served on the council. In 1885 he was president of Section C, when the British Association met at Aberdeen, and subsequently received the degree of LL.D. from that university. In 1895 he was created a C.B., and in 1913 was made an emeritus professor of the Royal College of Science. He married in 1878 Jeannie Frances Jeyes, niece of a well-known Northamptonshire geologist, who with a son and a daughter survive him.

A list of Judd's geological papers up to 1905 (after which they become rather infrequent) is added to a biography in the *Geological Magazine* for 1905. The majority fall into groups, determined by his successive fields of work, almost all appearing in the *Quarterly Journal* of the Geological Society or the *Geological Magazine*. The first group contains papers on the Neocomian, the most noteworthy clearing away many difficulties from the Speeton Clay, and showing its relation to the Neocomian beds of the Lincolnshire wolds and of North Central Europe. Another and most important group of papers deals with the Italian islands, mentioned above, the crater lakes of Central Italy, and Lake Balaton, with the old volcano of Schemnitz in Hungary, after which the older volcanic districts, especially those connected with the Alpine system, are discussed. A third not less important group refers to Scotland, in which he investigated sundry igneous rocks on the mainland and those of Tertiary age in Skye and other islands of the western coast. These papers put an end to many misunderstandings and added much to our knowledge, although his view that the gabbro is later than the granite has not been accepted by the Survey. That also, expressed in two papers, on the relation of the fluviomarine beds of Headon Hill and Colwell Bay in the Isle of Wight has not found favour, but the two on deep borings in the London district added much to our knowledge of the underground geology of south-eastern England.

For minor papers we must refer to the abovenamed list, but must not forget his presidential

address; the one on past and present relations between geology and mineralogy, the other on those between mineralogy and palæontology, where he attributed life to crystals, or his study of the borings in the Nile Delta, his petrological investigations of the rocks ejected from Krakatoa in 1883, and his studies of the materials from the Funafuti borings, all published by the Royal Society. The last involved much organisation, of which he took the lion's share. The Survey memoir on the geology of Rutland (1875) was written by him, and a small but excellent book on volcanoes in 1878. He twice revised and added much to Lyell's "Students' Elements of Geology" (1896 and 1911), and contributed the "Coming of Evolution" to a Cambridge series. In this small volume he tells the story, brightened by his reminiscences of the chief actors, in a most attractive way. He was a man whose like will not readily be found. T. G. BONNEY.

DR. PIERRE CHAPPUIS-SARASIN.

PHYSICAL science has suffered a severe loss in the death of Dr. Pierre Chappuis-Sarasin, formerly of the Bureau International des Poids et Mesures at Sèvres, who passed away at Basle on February 15.

Dr. Chappuis was born in Switzerland in 1856, and his early youth was spent in his native country. In 1881 he joined the staff of the Bureau International, then under the directorship of Dr. O. J. Broch. One of the most important early tasks of the newly-founded International Committee of Weights and Measures was to place upon a proper basis the whole system of the measurement of temperature, to define with precision the temperature-scale to which all measurements relating to length and mass were to be referred, and to set up the necessary ultimate standards. The classic work of Regnault and of Rowland had shown that practical realisation of temperatures by the gas-thermometer depended on the working limits of pressure adopted and the choice of the gas selected as thermometric substance. It was to the solution of the problem of a satisfactory ultimate thermometric standard that Dr. Chappuis at once devoted himself, and his brilliant investigations carried on at the Bureau over a period of more than twenty-two years have won him a place in the very front rank of physicists concerned with the science of exact measurement. His classic memoir on the gas-thermometer published in vol. vi. of the "Travaux et Mémoires" describes his researches on the coefficient of expansion of different gases suitable for thermometric substances, and led to the adoption by the International Committee in 1884 of the fundamental hydrogen scale of temperature.

Among other investigations may be mentioned his determination of the volume of the kilogram of water, employing the optical methods of Benoit and Michelson, and measurements to very high precision of the expansion of mercury and of water.

Family claims and the call of his native mountains led Chappuis to resign his connection with the Bureau and return to Switzerland in 1903, adopting the additional name of Sarasin, to which well-known family his wife belonged. He built himself a fine private laboratory at his house at Basle, where until quite lately he continued his researches. His last considerable piece of work, hitherto unpublished, was a redetermination of the sulphur boiling point. In these experiments the quartz reservoir of the gas-thermometer was directly immersed in sulphur vapour.

M. Chappuis was of a retiring disposition, disliking self-advertisement, and rarely appeared on scientific platforms. He visited the British Association at the Dover meeting. It is impossible for one who knew him well to conclude this memoir without a tribute to his genial disposition, his indomitable energy and high personal character. All who knew him in his hospitable home at Sèvres or Basle will feel they have lost a true friend. J. A. HARKER.

A COMMONWEALTH INSTITUTE OF SCIENCE AND INDUSTRY.

WE have just received a copy of the report of a committee appointed in pursuance of a motion passed at a conference convened by the Prime Minister of the Commonwealth of Australia that "An Advisory Committee be constituted to formulate proposals to the Government to establish a Commonwealth Bureau of Science and Industry." The members of the committee were: Representatives of universities:—Sydney—Sir T. Anderson Stuart; Melbourne—Prof. Orme Masson; Queensland—Prof. A. J. Gibson; Adelaide—Sir Douglas Mawson. Interstate Commissioners:—Mr. A. B. Piddington, the Hon. G. Swinburne. The Associated Chambers of Commerce of Australia:—Mr. W. T. Appleton. The Associated Chambers of Manufactures of Australia:—Mr. W. W. Forwood, Messrs. G. D. Delprat, W. P. Wilkinson (Commonwealth analyst), W. S. Robinson, J. M. Higgins, W. Russell Grimwade, E. W. Knox. Ex-officio Members:—Prime Minister of the Commonwealth; the Hon. F. Hagelthorn, Minister of Agriculture, Victoria; the Hon. W. Lennon, Minister of Agriculture, Queensland; the Hon. C. Goode, Minister of Agriculture, South Australia.

It will be noticed that the committee includes representatives of commerce and manufacture as well as of science and departments of State. We understand that the committee's report, which is subjoined, has the approval of the Federal Government, and that it is probable a Bill will be laid before the Federal Parliament to give effect to the recommendations after the Prime Minister's return from his present visit to England. The proposals of the committee are on lines somewhat similar to those of the British Government's scheme for the organisation and development of scientific and industrial research. Primary as well as secondary industries are included, and particular notice may be directed to the recommendations as to the governing body

of the proposed institute, by which, as consistently advocated in our columns, the balance of power is placed in the hands of men of science. We are fortunate in being able to publish this valuable report.

I.—*Introduction.*

The committee appointed in pursuance of the motion set out above met in the Cabinet Room, Commonwealth Offices, on January 6, 7, 8, 12, and 13, 1916.

The committee, in formulating the following scheme, has been greatly impressed with the magnitude and the possibilities of the proposals made by the Prime Minister, and is strongly of opinion that the time has arrived for initiating the extensive scheme of scientific research work in connection with industry which he has outlined.

The committee is convinced that the results of properly conducted investigations into many of the subjects referred to in his address will amply repay considerable expenditure and fully justify a bold and comprehensive policy being adopted. Not only will the results be a greatly increased productivity and output in many directions—in both primary and secondary industries—but the stimulus generally given to scientific research in relation to our industries will exert a powerful influence on our educational institutions and bring them and the industrial community to realise the commercial value of science more fully than hitherto. In fact, the initiation of the scheme will, in the opinion of the committee, go far to inaugurate a new era in the economic and industrial life of the Commonwealth.

The proposals which follow will provide for the formation of a Commonwealth Institute of Science and Industry under the control of directors of the highest business and scientific attainment, acting with the advice and co-operation of a council representing science and the primary and secondary industries of Australia.

II.—*Recommendations.*

(1) There should be established under Act of Parliament a Commonwealth Institute of Science and Industry.

(2) The functions of the institute should be :—

(i) To consider and initiate scientific researches in connection with, or for, the promotion of primary or secondary industries in the Commonwealth.

(ii) The collection of industrial scientific information and the formation of a bureau for its dissemination amongst those engaged in industry.

(iii) The establishment of national laboratories.

(iv) The general control and administration of such laboratories when established.

(v) To promote the immediate utilisation of existing institutions, whether Federal or State, for the purposes of industrial scientific research.

(vi) To make recommendations from time to time for the establishment or development of special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades.

(vii) The establishment and award of industrial research studentships and fellowships, to include either travelling fellowships or fellowships attached to particular institutions.

(viii) To direct attention to any new industries which might be profitably established in the Commonwealth.

(ix) To keep in close touch with, and seek the aid of, all Commonwealth and State Government Departments, learned and professional societies, and private enterprises concerned with, or interested in, scientific industrial research.

(x) The co-ordination and direction of scientific investigation and of research and experimental work with a view to the prevention of undesirable overlapping of effort.

(xi) To advise the several authorities as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

(xii) To recommend grants by the Commonwealth Government in aid of pure scientific research in existing institutions.

(xiii) To seek from time to time the co-operation of the educational authorities and scientific societies in the States with a view of advancing the teaching of science in schools, technical colleges, and universities, where its teaching is determined upon by those authorities.

(xiv) To report annually and from time to time to Parliament.

(3) The committee gave careful attention to the relation between the proposed institute and the existing Commonwealth Laboratory. It was recognised that the daily routine of Customs, naval and military stores, and other departments requires the performance of a great deal of important scientific work, particularly chemical analysis of material, and that the laboratories in which such routine scientific work is carried out must necessarily remain under departmental control, though they might with advantage be co-ordinated and their equipment increased. On the other hand, as the work of the proposed institute develops there will be an increased scope for work in national laboratories devoted to special branches of research and experimental investigation which are not otherwise provided for. Such laboratories and their scientific staffs should, in the committee's opinion, be kept distinct and placed under the control of the institute.

In the future it will be necessary to undertake experimental work in connection with the growth of our naval and military defence, the testing of materials with regard to the physical reasons underlying deterioration and change of structure due to mechanical and heat treatment, and as to failure in operation under varying conditions, the testing and trying out of processes in connection with the metallurgical industry and biological and geological problems.

The highly specialised intricate work of standardising electrical instruments and other scientific apparatus for use as substandards by different Government departments and other institutions in which research work may be carried on would also naturally fall within the functions of the institute.

A convincing reason for drawing a line of distinction between laboratories primarily for scientific research and laboratories primarily for the necessary routine work of departmental testing is that any attempt to combine the two would lead to confusion and hamper and weaken both branches of activity, and would tend to drown the research work for which the institute is being created.

It cannot be too strongly insisted that the qualifications of a staff for "researching" are different in character from those of a staff which is to carry out scientific routine testing.

The committee therefore recommends that :—

(*a*) The control of the present Commonwealth laboratories be not disturbed, but that they be co-ordinated, their staff increased, and their equipment improved.

(*b*) Any new national laboratories which may be created for special purposes of research and experimental inquiry, including a physical laboratory for testing and standardising purposes, should be controlled by the institute.

(4) With regard to the constitution of the institute the committee passed the following resolutions :—

(i) "That an Advisory Council consisting of nine members representing science and the principal primary and secondary industries be appointed who shall advise and co-operate with the directors in framing the policy and in the administration of the institute."

(ii) "That the members be appointed by the Governor-General in Council."

(iii) "That for the purposes of controlling and administering the institute and of collecting information and determining on the researches to be undertaken and directing their elucidation, three highly qualified salaried directors, of whom one should be chairman of the directors, shall be appointed by the Governor-General in Council. The directors shall seek the advice and co-operation of the Council and shall be *ex-officio* members thereof."

(iv) "That of the three directors one should be an expert business and financial man with ability in organisation; the other two should be chosen mainly on account of scientific attainments and wide experience."

(v) "The tenure of the directors shall be fixed by the Act."

(vi) "That the scientific staff should be appointed by the Governor-General in Council on the recommendation of the directors."

(5) The committee further resolved as follows:—

(i) "That all discoveries, inventions, improvements, processes, and machines made by workers directly employed by the institute should be vested in trustees appointed by it as its sole property, and should be made available, under proper conditions and on payment of gratuities or otherwise, for public advantage."

(ii) "That the council of the institute should be empowered to recommend to the Government the payment of bonuses to successful discoverers or inventors working under the auspices of the institute."

(iii) "That the institute should be empowered to charge fees for special investigations subject to regulations approved by the Governor-General in Council."

(6) Though these matters are not directly connected with the proposed institute the committee passed two further resolutions:—

(i) "That steps should be taken with a view to co-ordinating the work of our technical colleges and trade schools throughout Australia, so that a supply of scientifically taught craftsmen will be available to support the expansion of industry that it is hoped will result from the operations of the Institute of Science and Industry."

(ii) "That with a view to promoting our export trade in Australian products it is desirable that serious attention be given to the study of modern languages, including Oriental languages, for commercial purposes."

Immediate Arrangements.

(7) The committee realises that the establishment of the institute will necessarily involve some delay, but being impressed with the urgent need for work of the character proposed the committee resolved as follows:—

(i) "That until the institute is established an Advisory Council be appointed by the Governor-General in Council particularly to carry out the objects expressed in resolutions 2 (i) and (ii), viz.: 'To consider and initiate scientific researches in connection with, or for, the promotion of primary or secondary industries in the Commonwealth,' and (ii) 'The collection of industrial scientific information and the formation of a bureau for its dissemination amongst those engaged in industry.'"

(ii) "That the Federal and State Munitions Committees, heads of the Commonwealth and State scientific departments, and bodies representative of Commonwealth manufacture, commerce, agriculture, mining, and engineering, the universities and technical colleges, and private enterprises, be invited to suggest branches of industrial scientific research in which investigation would be of immediate practical use to producers and manufacturers."

(iii) "That the Advisory Council be appointed forthwith, and that when appointed it immediately take steps to initiate research work into the most pressing matters needing investigation and seek the co-operation of existing institutions and utilise the resources of staff and equipment at our disposal at the present time."

(iv) "The committee suggests for the consideration of the Advisory Council that the following problems, among others, are pressing:—The sheep fly pest; improved methods of extracting zinc from Australian ores, including the commercial manufacture of electrolytic zinc; the utilisation of brown coal with recovery of by-products; the introduction of a mechanical cotton picker; the eradication of the prickly pear; the production of aluminium and ferro alloys; the recovery of potash, manufacture of alkali, and condensation of sulphurous acid gas at present being wasted; the cultivation of useful indigenous grasses and salt-bushes; the manufacture of fine chemicals, drugs, and explosives.

It is, of course, impossible to predict, in matters of research, what the outcome of investigations may be. And the committee realises that not all the above subjects can be examined to the point of final results during the interval before the institute gets to work. The committee, however, suggests that in many, if not all, of the above matters most valuable work could be done in collecting data, and, in effect, making a preliminary census both as to present discoveries, and the staff and apparatus available in Australia. Such work is an indispensable first step in all research.

In addition to this, there is ample scope for practical work during the interval in vigorously prosecuting the dissemination of known information as to processes, etc., amongst our producers and manufacturers.

(v) "That funds be placed at the disposal of the Advisory Council for the above purposes."

(8) The committee desires to thank the Prime Minister for having placed at its disposal the services of Mr. Gerald Lightfoot, barrister-at-law, whose work as secretary has been greatly valued by the committee.

(Signed) Orme Masson (chairman), A. B. Piddington, G. D. Delprat, W. Russell Grimwade, J. M. Higgins, Wm. S. Robinson, George Swinburne, Alex. J. Gibson, Douglas Mawson, W. W. Forwood.

(Signed) Gerald Lightfoot, secretary to committee.

NOTES.

WE are glad that the *Times* has published in its Educational Supplement for March 7 a selection of letters upon the place of science in education received since the publication of the recent memorial on the neglect of science, to which we have referred on more than one occasion. The memorial was drawn up by a small committee of public-school science masters, and the thirty-six distinguished men of science who signed it subscribed to the views expressed in it without themselves being actively concerned with the construction of the document. If they and the professors at the Imperial College who supported them in a later short memorial to Lord Crewe, the chairman of the

governors of the college, had met and discussed in detail the subject of science in national affairs, we might have had a manifesto which would have outlined a national programme on a scientific basis, instead of a memorandum on the defects of the public-school curricula and Civil Service examinations as regards the study of science, and their consequences in public administration and legislation. There is not much new to be said upon these subjects, and the scientific aspects have been surveyed in our own columns from every point of view. In a leading article the *Times* Educational Supplement acknowledges that men of science will have little difficulty in establishing the following contentions:—(1) That much of our present teaching is antiquated, and, in method, unscientific; (2) that natural science, if taught at all, has too small a place in the average curriculum; and (3) that our social organisation makes it far easier for literary than for scientific ability to find its level. These undoubted defects might well be placed before a committee, independent of any Government department, appointed to inquire into the entire question of the organisation of our educational system, as suggested by Sir Philip Magnus. The subject should be included in the national programme which, we learn from a letter by Sir William Mather and Sir Norman Lockyer, is being deliberated by the British Science Guild. Any suggestions for such a programme should be sent to the honorary secretaries of the Guild, 199 Piccadilly, W.

Further regulations under the Defence of the Realm Act, issued on March 1, contain provisions prohibiting speculative transactions in the various metals required in the production of war material. The new regulation provides that it shall not be lawful for any person on his own behalf, or on behalf of any other person, to sell or buy iron (including pig-iron), steel of all kinds, copper, zinc, brass, lead, antimony, nickel, tungsten, molybdenum, ferro alloys, or any other metal which may be specified as being a metal required for the production of any war material. Rather curiously, tin, which is an important constituent of many naval alloys, including Admiralty gun-metal and Admiralty brass, and the price of which is very liable to sudden and large fluctuations owing to speculation, is absent from this list. On the face of it this metal should certainly have been included. The effect of these regulations on the operations of the metal exchanges of London, Birmingham, and Glasgow was at once evident. All business in regard to the above metals and alloys was suspended. A sobering influence on market prices should certainly result. A deputation from the London Metal Exchange was to discuss the situation with the Minister of Munitions on March 3.

Prof. W. Kilian, of Grenoble, has contributed to the *Revue Scientifique* (vol. liv., pp. 33–40) a long and interesting article on proposals for the organisation of scientific research in France after the war. He points out how pre-eminent Germany has become in the provision of bibliographies, synoptical treatises, other works of reference, more or less international journals, and materials of every kind for laboratory work and the lecture-room. Writing as a geologist, he is able to enumerate many important illustrations with which the efforts of French scientific men and publishers compare very unfavourably. While admitting that the progress of science must never be hampered by international boundaries, he urges the importance of some organisation for raising the prestige of French science in the early future. He proposes that an association be formed for the better co-ordination of work in providing bibliographies and reference books; that more posts be endowed for pure scientific research; and that more effort be made to secure for French scientific men a fair proportion of the appointments abroad, which are usually filled by graduates from the great European universities.

The sixth annual May lecture of the Institute of Metals will be given on Thursday, May 4, by Prof. W. H. Bragg, on "X-Rays and Crystal Structure, with Special Reference to Certain Metals."

The twenty-fifth annual meeting of the Royal Society for the Protection of Birds will be held at the Middlesex Guildhall, Westminster, S.W., on Thursday, March 16. Mr. Montagu Sharpe, chairman of the council, will take the chair at 3 p.m.

We learn from the *British Medical Journal* that Prof. M. Weinberg, of the Pasteur Institute, Paris, will deliver a lecture on bacteriological and experimental researches on gas gangrene before the Royal Society of Medicine (1 Wimpole Street, London, W.), to-morrow (Friday), at 5 p.m.

The prize of 10*l*. and a silver medal, offered under the Peter Le Neve Foster Trust by the Royal Society of Arts, for an essay on "Zinc: its Production and Industrial Applications," has been awarded to Mr. J. C. Moulden, of Seaton Carew, co. Durham. Honourable mention has also been awarded to Mr. E. A. Smith, deputy assay master of the Sheffield Assay Office, for his essay.

The Rev. E. W. Barnes, F.R.S., Master of the Temple; Mr. E. Newton, president of the Royal Institute of British Architects; and Prof. T. F. Tout, professor of medieval and ecclesiastical history in the Victoria University of Manchester, have been elected members of the Athenæum Club, under the rule which empowers the annual election of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

There will be a discussion on "The Sphere of the Scientific and Technical Press in Relation to Technical Education and Industrial Research" at the next meeting of the Circle of Scientific, Technical, and Trade Journalists, on Tuesday, March 14, in the hall of the Institute of Journalists (Tudor Street, Blackfriars, London, E.C.). The chairman of the circle, Mr. L. Gaster, will preside, and the discussion will be opened by Dr. William Garnett, late educational adviser to the London County Council.

The following new officers and members of council were elected at the annual general meeting of the Institute of Chemistry on March 1:—*Vice-Presidents*: Dr. A. Harden and Prof. Herbert Jackson. *Members of Council*: Mr. R. Bodmer, Mr. H. C. H. Candy, Prof. G. G. Henderson, Mr. P. H. Kirkaldy, Dr. A.

Lauder, Mr. Bedford McNeill, Prof. G. T. Morgan, Mr. D. Northall-Laurie, Mr. G. Stubbs, and Mr. T. Tickle.

The Faraday Society will hold an informal discussion on "Methods and Appliances for the Attainment of High Temperatures in the Laboratory," on Wednesday, March 15, at 8 p.m., at the Institution of Electrical Engineers, Victoria Embankment, London, W.C. Dr. J. A. Harker, of the National Physical Laboratory, will open the discussion, over which Sir Robert Hadfield, the president of the society, will preside. Workers interested in the subject, and particularly those prepared to speak on the results of their personal experiences, are invited to be present and take part in the discussion. Further particulars may be obtained from Mr. F. S. Spiers, secretary of the society, 82 Victoria Street, London, S.W.

The following officers and council of the Geological Society of London have been elected for the ensuing year:—*President*, Dr. A. Harker; *Vice-Presidents*, Sir T. H. Holland, Mr. E. T. Newton, the Rev. H. H. Winwood, and Dr. A. Smith Woodward; *Secretaries*, Mr. H. H. Thomas and Dr. H. Lapworth; *Foreign Secretary*, Sir Archibald Geikie; *Treasurer*, Mr. Bedford McNeill. In addition to these officers the members of the new council are:—Mr. H. Bury, Prof. J. Cadman, Prof. C. G. Cullis, Mr. R. M. Deeley, Prof. W. G. Fearnsides, Dr. W. Gibson, Dr. F. L. Kitchin, Dr. J. E. Marr, Mr. R. D. Oldham, Mr. R. H. Rastall, Prof. T. F. Sibly, Prof. W. J. Sollas, Dr. J. J. H. Teall, and Mr. W. Whitaker.

The third Indian Science Congress met at Lucknow on January 13–15. The growing interest in scientific inquiry observable in India is evidenced by the rapidly increasing popularity of this body. In spite of the war, about seventy papers were read at the congress and more than 300 visitors attended the meetings. The list of papers discloses a surprisingly large volume of scientific work in India, and there is every reason to look for a successful and useful future of the congress. The presidential address was delivered by Sir S. G. Burrard, F.R.S., who took as his subject "The Plains of Northern India, and their Relationship to the Himalaya Mountains." Sir A. G. Bourne, F.R.S., has been elected president for 1916–17, and the next meeting will probably be held at Bangalore.

We have received a provisional programme of the eighth meeting of the Italian Society for the Advancement of Science, arranged to be held at the Royal University of Rome on March 1–4. The session was originally intended to be held at Bari, but as this city is too near the theatre of war it was resolved to meet at Rome instead. The president was Prof. Camillo Golgi, the vice-presidents being Prof. Guido Castelnuovo and Prof. Vittorio Rossi, and the secretary Prof. Vincenzo Reina. The inaugural address, delivered by Prof. G. Cuboni, dealt with the problems of agriculture at the present time. General discourses were given by Prof. R. Nasini on Italian chemistry; by Prof. G. Valenti on hydraulic problems and water legislation; by M. Pantaleoni on economic lessons of the war; by G. Luigi on eugenics and the decay of nations; and by P. Fedele on imperialism in German history. Sectional papers were given by G. Levi on inorganic chemical industry; by E. Molinari on the industry of some important organic compounds; by F. Garelli on the industry of fats; by E. Miolati on electrochemical industry; by M. Ascoli on electrotechnics; by E. Bianchi on the state of the Italian industry of geodetic-astronomical instruments; by P. Gamba on the exploration of the upper atmosphere. In the medical-hygienic section C. Moreschi dealt with the prophylactic use of antityphoid and anticholera injections; V. Pensuti with vaccino-therapy of typhoid; and A. Perroncito and G. Grixoni with hygienic problems of modern war. A list of philosophical and geographical papers is also given in the programme issued.

The death is announced of Prof. Vladimir A. Tichomirov, professor of pharmacy and materia medica at Moscow University and Russian Councillor of State.

The death has occurred at Sheffield, in his sixty-fourth year, of Mr. G. T. W. Newsholme, who was the first provincial pharmacist to occupy the position of president of the Pharmaceutical Society. Mr. Newsholme became vice-president of the society in 1897, and in 1900 was elected president, holding the office for three years. He was a governor of Sheffield University.

The death is announced, in his fifty-eighth year, of Dr. J. Nelson, a native of Copenhagen, and a graduate of the University of Wisconsin, who had occupied the chair of biology at Rutgers College, New Jersey, since 1888. He had also held various scientific appointments under the State of New Jersey, including membership of a tuberculosis commission and the post of investigator of oyster culture.

Mr. L. Duncan, formerly associate professor of applied electricity at Johns Hopkins University, and head of the department of electrical engineering at the Massachusetts Institute of Technology, has died at the age of fifty-three. He was twice president of the American Institute of Electrical Engineers, and had written on electric traction for the "Encyclopædia Britannica." He served as consulting engineer during the electrification of the transit systems of New York.

The death is announced, in his eighty-first year, of Dr. W. A. Knight, emeritus professor of moral philosophy in the University of St. Andrews. Prof. Knight was the author of many literary works, including "Studies in Philosophy and Literature" (1879), "Essays in Philosophy, Old and New" (1890), and "Varia, being Studies on Problems of Philosophy and Ethics" (1901), but he will be remembered chiefly as the devoted editor and interpreter of the poet Wordsworth and the Wordsworth family.

The death has occurred in his sixtieth year of Prof. Pietro Grocco, director of clinical medicine in the R. Istituto di Studi Superiori of Florence. After studying in Paris and Vienna he was, we learn from the *Lancet*, appointed to a chair of practice of medicine at Perugia, which he occupied for three years, when he was elected to a post on the same subject at Pisa, whence

in 1892 he was transferred to Florence. The Florentine school enjoyed his special care and generosity, founding as he did, mainly from his own resources, the Istituto Antirabico on the lines of Pasteur, and making the thermal waters of the neighbouring Montecatini a balneary centre in practical connection with his courses on the vast group of rheumatoid maladies. In 1905 he was made a senator of the kingdom, in accordance with Italy's custom to promote men of scientific distinction to the Upper Chamber, and here again his advice on intervention was of public benefit in more than one hygienic departure.

THE death is announced, at seventy-two years of age, of Prof. E. Heckel, professor of botany in the University of Marseilles. We learn from the *Chemist and Druggist* that after the war of 1870 he became head pharmacist at Montpellier and assistant-professor at the local School of Pharmacy. Five years later he accepted the post of professor of natural history at the Nancy School of Pharmacy, but his stay there was short. After a few months at the Grenoble Faculty of Sciences, Heckel obtained two professorial chairs at Marseilles, teaching botany at the Faculty of Sciences and materia medica at the School of Medicine. To these double duties he added those of director of the Botanic Garden of Marseilles. In 1880 his contributions to science were recognised by his election to the corresponding membership of the Paris Academy of Medicine, and later by a similar election at the Academy of Sciences. It was in 1892 that he founded the Colonial Institute, where he placed his collections. He specialised in the study of such tropical plants as were likely to be of value for alimentary purposes or local industry, and his name is associated with the introduction of several of them into France.

THE *Times* of March 2 reports the death of Ernst Mach, once professor of physics in the University of Prague, but for the greater part of his academic life professor of the history and theory of inductive science at Vienna. The news will cause widespread regret, for, though Mach was not a great investigator or constructive thinker either in positive science or in philosophy, he did admirable secondary work for both by his illuminating interpretations of the history of physics. His psychological investigations, best represented by his book on "The Analysis of Sensations," had technical merits which earned high praise from so competent a judge as William James. They are interesting chiefly, however, as "studies" in the radical empiricism that found its most characteristic expression in his epistemological essays—particularly in his "Science of Mechanics." The essential positions of this famous work were (as Mach pointed out pathetically) published so long ago as 1868, that is, six years before Kirchhoff astonished the scientific world by the announcement of similar but less thoroughgoing views. The book itself appeared in 1883. It has undoubtedly had great influence not only upon current views as to the real nature of science, but also upon the actual development of mathematical physics from Hertz down to the relativists of the present day. In a farewell communication which the unhappy state of Europe makes the more dignified and touching, Prof. Mach "sends greetings to all who knew him and asks for serene remembrance." Men of good will in all countries will respond to the wish, for no chauvinistic bias distorted Mach's vision of the progress of the human spirit, and none has shown more clearly than he that in the disinterested pursuit of knowledge men of all times and tongues are members one of another.

THE recent completion, almost simultaneously, of three masonry dams for the main impounding reservoirs of important water supply systems in this country is an event somewhat unique in its way. None of the three structures—the Angram, the Derwent, and the Alwen Dams—is perhaps of such magnitude as the Kensico Dam in the United States, to which reference was made in our issue of January 27 (p. 602), but they are all noteworthy examples of this department of waterworks engineering. The Angram Dam, in Yorkshire, holds up 1250 million gallons of water derived from the river Nidd and the Stone Beck, for the supply of the town of Bradford. The capacity of the reservoir formed by the Derwent Dam is 2000 million gallons; it forms the second instalment of a great scheme destined to serve the Derwent Valley, including the towns of Leicester, Derby, Sheffield, and Nottingham, and the counties of Derby and Nottingham. There are to be five dams in all in this undertaking, and the first, the Howden Dam, of about equivalent storage capacity with the Derwent Dam, was completed some few years back. The third dam of the three forming the subject of our note, the Alwen Dam for the Birkenhead Corporation Water Supply, holds up 3000 million gallons from the river Alwen. The reservoir capacity is thus much greater than that of either of the other two dams, but the structure itself is smaller, both as regards length and height. The crest is only 458 ft. long, and the height from the river bed 90 ft., whereas the crest of the Derwent Dam is 1110 ft. in length and 114 ft. in height, and the crest of the Angram Dam 1200 ft. long, and its height 130 ft.

THE Madras Museum has done good service to the study of Indian antiquities by publishing a new edition of the catalogue of prehistoric antiquities collected by the late Mr. R. B. Foote, which forms the most valuable portion of the museum collections. To this has been added a catalogue of the prehistoric antiquities, collected by Mr. A. Rea, of the great burial grounds of Adichanallur and Perumbair. These collections contain a large number of specimens of objects in metal and pottery, which are of the highest value for the study of the early history of the Dravidian races.

IN his presidential address to the Hellenic Society, published in part ii. of the Proceedings of the Society in 1915, Dr. W. Leaf discussed the history of Greek commerce, a subject dealt with in his important work on Homer and history, recently reviewed in these columns. He made the interesting suggestion that the society should undertake an edition of at least the three books of "Strabo's Geography" describing Asia Minor. This should be on the lines of Sir James Frazer's edition of "Pausanias," dealing in the first instance with topography, and summarising the stores of epigraphic and numismatological information, with an account of the many characteristic religions and myths of that region. Sir William Ramsay and Mr.

Hogarth have promised to assist in the proposed edition of Strabo, and it may be hoped that after the close of the war the Hellenic Society will be in a position to undertake this important work, which will be of the highest value to historians and geographers.

A VERY acceptable addition to our knowledge of the nesting habits of the Australian mistletoe-bird (*Dicaeum hirundinaceum*), by Messrs. S. A. Lawrence and R. T. Littlejohn, appears in the *Emu* for January. The authors were so fortunate as to be able to study the final stages of the building of the nest, and later to obtain photographs, both of the parents and nestlings. The former displayed extraordinary confidence, allowing the nestlings to be removed from the nest and feeding them on the hand of one of the photographers. The tameness of these birds enabled the authors to watch closely the peculiar method employed by them in extracting the seeds of Loranthus berries, which constituted a large portion of the food of the young, insects completing the dietary. The same number also contains some valuable notes by Mr. Charles Barrett on the spotted bower bird, with a photograph of its remarkable bower, or playing ground. This most interesting bird is unfortunately incurring the resentment of the fruit-growers on account of the damage it is said to inflict on the orchards, a charge, however, which does not seem to have been established.

IN the January number of that admirable journal, *California Fish and Game*, it is announced that an attempt is to be made to interest the fish-dealers of San Francisco in a project for the production of caviare from the roes of salmon and shad. M. Cotoff, a Russian expert, is the moving spirit in this project, which, it is to be hoped, will meet with success, since about half a million pounds of salmon roe from the canning stations in San Francisco are thrown away annually. It is claimed that caviare thus made will exceed in quality the imported caviare made from the sturgeon. The same number contains a lucid account of experiments which have been made recently to test the effect of strychnine sulphate on the California Valley quail. Barley soaked in this poison is now used to eradicate the ground squirrels, and hence it was feared the quail might be involved in their destruction. Experiments have shown, however, that the squirrels are very susceptible to strychnine, while the quail, under natural conditions, may consume relatively large amounts of this poison without hurt. This conclusion has been arrived at in consequence of a series of experiments on a number of captive quail. In one case 280 grains of barley containing no fewer than 40 milligrams of strychnine were ingested, and yet without any toxic symptoms, while, in a squirrel, 19 grains of barley containing as little as 2·7 milligrams of poison sufficed to produce convulsions and death within ten minutes. The grain in this case was not swallowed, but merely taken into the buccal pouches, where the poison was absorbed through the mucous membrane of the pouch. The maximum dose of poison taken by a squirrel was 5·7 milligrams taken up with 40 grains of barley, death taking place within an hour.

Symons's Meteorological Magazine for February inaugurates the commencement of the second half-century of its issue. A tentative summary of the rainfall over the British Isles for January shows that the general rainfall for England and Wales was 89 per cent. of the average, that for Scotland was 147 per cent., for Ireland 86 per cent., and for the British Isles as a whole 109 per cent. An article on "The Mildness of January, 1916, in London," presumably from the observations at Camden Square, shows the month to have been unique for its temperatures compared with the observations from 1858 to the present time. The mean temperature for the month was 45·7°, which is 7·2° above the average, and exceeds by 1·8° the next highest value, 43·9°, which occurred in 1884, A discussion by Mr. H. A. Hunt, Commonwealth Meteorologist, on the "Temperature Departures in Australia, 1915," exhibits the remarkably warm winter and greater part of the year 1915, the excess of temperature in June and July being more than 5° over Central Australia. The article is illustrated by a series of temperature charts embracing the whole of Australia.

THE series of articles on the "Economic Resources of the German Colonies" in the Bulletin of the Imperial Institute is concluded in the current number (vol. xiii., No. 4) with an article on Germany's recent possessions in the Pacific. The large amount of zinc required for war purposes and the resulting increased demand lend special interest to an article on the sources of the metal within the British Empire. By far the most important zinc deposits in the Empire are those of the Broken Hill Mines, New South Wales, the output of which alone is sufficient to supply the entire demands of the United Kingdom. The Broken Hill ore before the war went mainly to Germany for smelting, but the Australian Government has adopted measures which will prevent this in the future. The issue also contains useful reports based on the work done at the Imperial Institute on Indian opium, tobacco from Cyprus, copra from Queensland, cocoa from Nigeria, piassava from British West Africa, and asbestos from South Africa.

THE January number of the *Journal of the British Science Guild* contains a number of articles dealing with organisation and education and with the application of science to warfare. A letter written by the president, Sir William Mather, to the Prime Minister in July last, dealing with the application of the scientific resources of the country to the prosecution of the war, is printed in full. Of particular interest to opticians and glass manufacturers are the specifications of three types of microscopes and a list of educational institutions which have undertaken to use only British-made chemical glass apparatus during the war and for a period of three years after. Dr. H. S. Willson contributes an article on organisation and education. The part played by science in war is dealt with by "Anagapa." Prof. R. A. Gregory contributes a timely article on the introduction of the metric system. Experience of the past eighteen years has shown that permissive legislation is not of much practical effect. The Weights and Measures Act of 1897 rendered it lawful to use the metric system in this

country for the general purposes of trade, but little advantage has been taken of it, either in internal or external trade. The system must be made compulsory before the trading community as a whole will take advantage of it. Several recent instances show that the metric system can be introduced without the difficulties which some people suppose would come with it.

An article by Mr. R. G. Skerrett in the *Scientific American* for February 12 describes Fricke's apparatus for locating vessels at sea during fogs. It depends on the difference in the time required for a wireless signal and for a sound signal sent out from the same point at the same instant to reach some distant point. This difference is proportional to the distance apart of the sending and receiving points. The receiving apparatus consists of a wireless receiver and sixteen telephones arranged at equal angular intervals round the ship, and so protected that each will respond only to sounds coming in approximately its direction towards the ship. The arrival of the wireless signal starts sixteen bands travelling outwards from a common centre towards the sixteen corresponding telephones. The arrival of the sound signal at the telephone directed towards the quarter from which the sound originates actuates a marking point carried by the corresponding band, and a mark is made on the under side of a piece of translucent paper placed over the bands and ruled with concentric circles representing the number of miles of the source from the vessel. The marking points are brought back to the zero circle after each observation, and a series of observations gives the direction, distance, and course of the source from the ship.

In the last number of the Proceedings of the Geologists' Association (December, 1915) Dr. A. Holmes gives a useful summary account of the manner in which the study of radio-active minerals can be applied to the measurement of geological time. The science of radio-activity has already destroyed the argument by which Lord Kelvin deduced a relatively short age for the earth from its apparent rate of cooling. But the same science also furnishes data for a direct estimate of the age of a rock which contains radio-active minerals. There is doubtless a considerable margin of error, but the best results are consistent, and seem to be reasonable. Prof. Strutt's method was based upon the accumulation of helium from the gradual break-up of uranium and thorium. Dr. Holmes takes instead the ratio of the final product, lead, to uranium, and his results are in general higher than Strutt's, probably owing to the loss of helium by leakage. Various Carboniferous and Devonian intrusions are estimated to have an age of the order of 300 to 400 millions of years, and for granitic intrusions of the Middle pre-Cambrian is deduced an age of the order of 1000 to 1200 millions of years. Such figures will be comforting to geologists who dislike hurrying unduly the operations of nature.

In the current number of the Transactions of the English Ceramic Society there are several important papers, notably one by M. Bigot on the distribution of heat in pottery ovens, and one on pottery pyrometry by Mr. R. W. Paul. There is a memorial lecture on the famous ceramic artist, M. Solon, by Mr. Hobson, of the British Museum, and a number of papers of purely technical interest by Messrs. Audley, Dressler, Guy, Hill, Mellor, Singleton, and Wilson. The English Society is doing good work in getting the empirical experience of the potters into a systematic form, so that the underlying principles may finally be made clear; and it is gradually winning for itself general recognition among the manufacturers who pay for the work of abstracting the home and foreign pottery, clay, and glass journals. These abstracts are an important feature of the journal.

The following forthcoming books of science are announced, in addition to those referred to in recent issues of Nature. By *George Allen and Unwin, Ltd.*—Elements of Folk Psychology: Outlines of a Psychological History of the Development of Mankind, W. Wundt, translated by E. L. Schaub; Anthropomorphism and Science: A Study of the Development of Ejective Cognition in the Individual and the Race, O. A. Wheeler. By *D. Appleton and Co.*—The Book of Forestry, F. F. Moon; The Care and Culture of House Plants, H. Findlay; The Fundamentals of Plant Breeding, J. M. Coulter; Sanitation in Panama, W. C. Gorgas; Irrigation Management, F. H. Nowell; Irrigation in the United States, R. P. Teele; The Theory of Steam Traction Engineering, S. R. Eighinger and M. S. Hutton; Minerals and Rocks, W. S. Bayley. By *A. and C. Black, Ltd.*—A Manual of Mendelism, Prof. J. Wilson; First Principles of Evolution, Dr. S. Herbert, new edition, illustrated; A Manual of Medical Jurisprudence, Toxicology, and Public Health, Dr. W. G. A. Robertson, new edition, illustrated; Diseases of Children, Dr. A. D. Fordyce, illustrated. By the *Cambridge University Press.*—A Factorial Theory of Evolution, Prof. W. L. Tower; Chemical Signs of Life, S. Tashiro (University of Chicago Science Series.) By *Cassell and Co., Ltd.*—Alfred Russel Wallace: Letters and Reminiscences, J. Marchant. By *J. and A. Churchill.*—Handbook of Colloid Chemistry: the Recognition of Colloids, Theory of Colloids, and their General Physico-Chemical Properties, Dr. W. Ostwald, translated by Prof. M. H. Fischer. By *John Murray.*—Agriculture after the War, A. D. Hall. By the *University of London Press.*—The New Regional Geographies, L. Brooks, vol. i., The Americas, vol. ii., Asia and Australia, vol. iii., Europe and Africa; An Economic Geography of the British Empire, C. B. Thurston. By *Witherby and Co.*, under the title, "A Veteran Naturalist," a life of the late Mr. W. B. Tegetmeier, by his son-in-law, Mr. E. W. Richardson.

With reference to the note in Nature of March 2 (p. 16), Mr. Perrycoste writes to say that he pointed out not only the advantages consequent on the suggested use of Latin, but the counterbalancing risks and the necessity of discarding Latin "prose-composition," as well as Latin verse.

In the article on "The Utilisation of Peat" in Nature of March 2, it should have been stated that the blocks of Figs. 1 and 2 were lent to us by the Department of Agriculture and Technical Instruction for Ireland, which, as stated on p. 19, publishes the pamphlet from which the article was abridged. Fig. 3 was from a block lent by the Power Gas Corporation, Ltd., Stockton-on-Tees.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ACTIVITY.—Sun-spot activity has been especially noteworthy during the past few days, a feature being the great extent and disturbed character of several of the groups.

COMET 1916*a* (NEUJMIN).—The discovery of the first comet of the year by M. G. Neujmin, of the Simeis Observatory, Crimea, on February 24 was announced last week. According to a telegram received last Friday from Prof. E. Strömgren, the comet was observed by Prof. Biesbroeck (Yerkes) on February 29, at 14h. 41·3m. G.M.T.; its position was R.A. 8h. 58m. 46·5s., declination $+13° 35' 14''$. The comet is thus a little south of κ Cancri.

COMET 1915*e* (TAYLOR).—On February 4, 1891, Dr. Spitaler, searching for Winnecke's comet, observed a cometic object that afterwards could not be refound. On the basis of the orbit calculated by M. J. Braae and Mlle. J. Vinter Hansen, Prof. A. Berberich finds (*Astronomische Nachrichten*, No. 4827) that this solitary observation possibly refers to comet Taylor. Assuming changes of $+6·5°$ and $-6·3°$ in longitudes of node and of perihelion respectively, and calculating the comet's place for $M=5·1°$, gives about the position of the object seen by Dr. Spitaler. Decided alterations in the position of the nodes due to perturbations by Jupiter were possible in 1901, and again in 1912–13. If perihelion occurred in 1891·0, then the interval, 25·1 years$=4\times6·27$, would be equivalent to four revolutions. Dr. Spitaler recorded that at about 9½h. he saw the object "between the faint stars lying together in the same parallel 20s. preceding the star DM$+26°$, 1714," *i.e.* R.A. 7h. 58m. 43s., declination 26° 15′. This position was in fairly close agreement with that calculated for Winnecke's comet according to the orbit of von Haerdtl.

THE ORBIT OF VV ORIONIS.—A paper by Mr. Zaccheus Daniel (Publications, Allegheny Observatory, vol. iii., No. 21) deals with this eclipsing variable and spectroscopic binary. Chief interest centres in the fact that situated within 1° of δ Orionis it is now found to present the same spectral peculiarity, the calcium K line not sharing the oscillations shown by the lines of other elements. Its spectrum is of the B2 type, and the lines are generally diffuse. The period, 1·4854 days, agrees with that previously found by Hartmann from photometric observations, but this rapid oscillation is superposed on a slower, having a period of 120 days. The velocities given by the K line are not quite constant, hence possibly the calcium atmosphere belongs to the system, and has an orbital movement in the same direction as the brighter component. The mean value from the K line is $+16·7$ km./sec., agreeing with the mean for δ Orionis ($+17·2$) and ϵ Orionis ($+15·6$), and with the value of the sun's motion away from that part of space. Thus the calcium vapour is stationary, but as the early type stars themselves have very small velocities, the present evidence does not settle whether the calcium belongs to the stars or not.

OBSERVATIONS OF VARIABLE STARS.—Dr. C. Hoffmeister (*Astronomische Nachrichten*, No. 4827) has recently published a considerable collection of observations of many Algol and short-period variables, and also of a number of suspected variables. Among the latter is η Ursæ Majoris, for which the present observations indicate a range of 0·3 magnitude. Dr. G. Hornig (*Astronomische Nachrichten*, No. 4828) gives dates of maxima and minima of ϕ Persei observed during November, 1914–April, 1915. The period of the latter star is found to be 18·1 days, very nearly one-seventh that found by Lau. Maxima date from November 28, 1914, and thus the next would be due March 12. The variation is of the Cepheid type ($M-m=7·5$ days). Observations of 7 Arietis, 15 Trianguli, and 31 Orionis show them to be irregularly variable in periods of about 70, 200, and 356 days respectively.

SEA-SPIDERS AND FEATHER-STARS.[1]

DR. CALMAN reports on the Pycnogons or sea-spiders collected by the British Antarctic Expedition of 1910. The collection far exceeds that of any Antarctic expedition yet reported on, comprising no fewer than forty-four species, eleven of which are new. There seems no doubt that Antarctic seas are far richer in these quaint, slow-living creatures than any other area of the oceans. While most of the species were obtained in very small numbers, this was not always the case, for we read that two hundred specimens of *Nymphon australe* were obtained at a single station, and presumably at a single haul.

The author discusses the meaning of the ten-legged species which occur, the great majority being eight-legged, and defends, against Prof. Bouvier, the view, which he shares with Prof. Carpenter, that the decapodous Pycnogons represent a recent specialisation, not a primitive survival. An interesting parallel is found in Pliotrema, a Pristiophorid shark, described by Mr. C. Tate Regan, which has six gill-arches instead of the usual five, but is evidently a very highly specialised form, derivable from some ancestor like Pristiophorus, with the normal number of arches.

Attention has been directed to the great range of variability in sea-spiders, but Dr. Calman does not think that it is greater than, for instance, in many groups of Crustaceans. And as to the theory of Döderlein, that lack of the power of wandering is a factor which favours the development of local races, varieties, and species in any group of animals, the author finds no corroboration in the case of Pycnogons, which are extremely slow-going creatures. Although some species can swim in the adult state, their efforts seem to be awkward and ineffective, and none of the larvæ are better adapted for locomotion. The memoir is marked by Dr. Calman's well-known carefulness of workmanship, and the illustrations drawn by Miss Gertrude M. Woodward are remarkably fine.

Mr. A. H. Clark is to be congratulated on the appearance of the first part of the monograph on present-day Crinoids, to which he has largely devoted his energies during the last ten years. The study of these singularly beautiful animals has been heretofore dominated by the palæontological approach, and not unnaturally, since the fossil record is extraordinarily complete, and not very many recent forms have been known or have been available for investigation. This, as the author says, has led to "the recent Crinoids being considered as the impoverished and decadent remnants of a once numerous and powerful class, the last forlorn and pitiful exponents of a dwindling phylogenetic strain. During the 1906 cruise of the *Albatross* I handled tens of thousands of specimens; several times I saw the forward deck of the steamer literally buried under several tons of individuals belonging to a species exceeding any fossil form in size; everywhere we went we found Crinoids; we dredged them at all depths."

[1] "British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology, vol. iii., No. 1, Pycnogonida." By Dr. W. T. Calman. Pp. 1–74+22 figs. (London: British Museum (Natural History). 1915.) Price 5s.

Smithsonian Institution. U.S. National Museum, Bulletin 82. "A Monograph of the Existing Crinoids." By A. H. Clark. Vol. i. The Comatulids. Part i. Pp. 1–406+17 plates+513 figs. (Washington: Government Printing Office, 1915.)

So Mr. Clark ceased to regard the group as decadent or degenerate, and became convinced that recent Crinoids play as important a *rôle* in the economy of the sea-floor as do the other Echinoderms. He has written his monograph, therefore, under the influence of a study of recent forms rather than of extinct forms.

The present instalment contains a general introduction, a history of investigation, a most elaborate glossary, and a general account of Crinoid structure which is strongest as regards skeletal parts, dealing rather sketchily with the "innards" and the development. We regret to see that the learned author defends the extraordinary view that Echinoderms are affiliated to Crustaceans and to barnacles in particular. To support this by "the very close correspondence between the development of the larvæ of the Echinoderms and that of the larvæ of certain types of Crustaceans," or by the correspondence between the crustacean eye and the asteroid eye, or by comparing the genital plates of a sea-urchin to the protopodites of the walking legs of a crayfish, or indeed by any of the arguments used, seems to us an extraordinary perversion of morphological judgment. Attention should be directed to the numerous graphic figures drawn by Miss Violet Dandridge for the text.

CHEMISTS AND THEIR TRAINING.

SPEAKING at the thirty-eighth annual general meeting of the Institute of Chemistry, held on March 1, Sir James Dobbie, the president, referred briefly to the work of the institute during the war and the importance of the services of professional chemists to the nation, particularly in the production of munitions and other material of war. His address is here summarised.

Both in the interests of the profession and of the industries of the country, the institute has encouraged by every means possible the production of laboratory requirements of all kinds hitherto obtained almost entirely from Germany and Austria. In co-operation with the Society of Public Analysts, steps have been taken to ensure supplies of satisfactory chemical reagents, and a number of British firms have undertaken their manufacture according to standards prescribed by a joint committee of the two societies.

The work of the Glass Research Committee of the institute has been remarkably successful. At the end of six months' work formulas were produced for practically all the various kinds of glass required in chemical operations, in addition to glasses for miners' lamps, pharmaceutical ampoules, and X-ray tubes. A number of manufacturers who have taken up these industries are now able to supply immediate requirements, and there is good reason to expect that within a short while they will have completely mastered the technique involved in the production of such articles. The credit for this achievement is due to Prof. Herbert Jackson, of King's College, London, assisted by Mr. T. R. Merton. The work of the committee has received the recognition of the Advisory Council on Scientific and Industrial Research, from whom grants have been received for the furtherance of investigations with a view to the determination of formulas for other glasses required for scientific purposes, including certain forms of optical glass.

As to the necessity for taking adequate measures for equipping ourselves for the economical struggle which must ensue when peace is restored, the discussions which have taken place on the subject have revealed a wide divergence of views, both as to the cause of the unsatisfactory position in which we found ourselves and the steps required to remedy it. In chemical industries, however, it is generally agreed that the relations between chemical science and chemical manufactures should be more intimate in the future than they have been in the past. That condition can be fulfilled only if the country possesses an ample supply of highly trained chemists. Dr. Beilby has expressed the belief that the remarkable development of chemical industry in Germany resulted much more from the large command of chemists and engineers of sound professional training than from the possession of an even larger supply of research chemists of mediocre ability. That opinion should not, however, be taken as giving the impression that the value of research is to be underrated. So far as the supply of chemists of sound professional training is concerned, we can face the future with some confidence, particularly as the facilities for training chemists have been remarkably increased. It has to be admitted, however, that the great public schools are, for the most part, unsympathetic towards the study of science, and, even when they are excellently equipped for the purpose, the results are meagre and unsatisfactory.

As to the older universities, it must be allowed that Cambridge has lately achieved an extraordinary measure of success in adapting its teaching to the needs of modern times, while the fact that Oxford is rousing herself to meet her responsibilities is shown by the terms of a memorandum issued by the Natural Sciences Board in support of a reform in the regulations for the honours degree in chemistry, whereby research will become a compulsory part of the curriculum. What must be advocated is a system of general education on broad lines throughout, including both classics and science, up to the proper age for specialisation. Should the expectation of the country in this matter not be realised, the inevitable result will be that schools established on more modern lines will gradually replace the old public schools as the training ground of the leaders of the nation.

The council of the institute is about to give further consideration to the problem of promoting a more complete organisation of professional chemistry in the interests of the industries of the country. Chemistry is a comparatively young profession, which is gradually establishing itself in the knowledge and the good opinion of the community. It will be successful in this in proportion as it attracts men of strong character and individuality, efficient and capable of holding their own as professional men. As it gains in strength its services will become more widely recognised and will meet with the same appreciation as that accorded to the older learned professions. The fact that the title chemist has long been identified in this country, alone of all European countries, with the craft of pharmacy is responsible for much of the confusion existing in the public mind, but the public is learning at present so much about the work of the chemist that we need not despair of seeing the day when it will be common knowledge that while in law all pharmacists are chemists, all chemists are not pharmacists.

We extract from the report of the council a statement as to the work on glass research to which Sir James Dobbie referred in his address.

The Advisory Council on Scientific and Industrial Research has allotted the institute a grant of 400*l.* for one year's research work on laboratory glass of various kinds, and a grant of 500*l.* for research on optical glass, covering a period up to March 31, 1916. The grants are made on certain conditions, providing for the use of the results by British firms on terms to be arranged between the Advisory Council, the Glass Research Committee, and the manufacturers concerned. The Glass Research Committee has lately for-

warded to the Advisory Council reports on formulas for :—Blue enamel for sealing metallic wire into glass; lead glass suitable for electric light bulbs; lead glass similar to above, but avoiding potassium carbonate; opal glass designed to join perfectly with glass made to the committee's formulas Nos. 1 and 10; high-temperature thermometer glass; a leadless opal glass which unites with No. 19 and can be worked with it as an enamel backing for thermometers, etc.; thermometer glass for ordinary temperatures.

The fact that these formulas are available has been reported to British glass-makers, from whom a large number of applications have been received and are now under the consideration of the authorities.

With regard to research on optical glass, the Advisory Council has asked that the Glass Research Committee shall keep in touch with the National Physical Laboratory, to which a grant has also been allotted. The primary object of the work of the laboratory will be "the study of the process and condition of melting and producing glass of good optical quality with special reference to refractories and electric furnace methods, with a view to putting the whole process of manufacture on a practical scientific basis."

The line of investigation undertaken by the Glass Research Committee of the institute is "the study of certain specific optical glasses urgently required for industrial purposes, with a view to their early production by manufacturers."

REPORTS OF CARNEGIE FOUNDATIONS.

A COPY of the year-book for 1915 of the Carnegie Institution of Washington has reached us. As usual, the bulky volume, which this year runs to 429 pages, contains not only detailed particulars of the large amount of scientific research carried out under the auspices of the institution, but full information of the income and expenditure of the corporation. The total financial receipts for the year 1915 amounted to 243,000*l.*, bringing up the grand total received since the inauguration of the institution in 1902 to 2,331,300*l.* The expenditure during 1915 may be summarised as follows :—Investments in bonds, 41,240*l.*; large projects, 154,100*l.*; minor and special projects, research associates and assistants, 21,914*l.*; publications, 9340*l.*; and administration, 9645*l.* The following list shows the departments of investigation to which the larger grants were made and the amounts allotted during the year :—

	£
Department of Botanical Research ...	8,123
Department of Economics and Sociology	600
Department of Experimental Evolution ...	9,784
Geophysical Laboratory	17,833
Department of Historical Research ...	6,280
Department of Marine Biology	3,830
Department of Meridian Astronomy ...	5,276
Nutrition Laboratory	9,013
Division of Publications	2,000
Solar Observatory	44,026
Department of Terrestrial Magnetism ...	28,262
Department of Embryology	6,436
Total	£141,463

A table showing the growth and extent of the institution's publications shows that, since 1902, two hundred and ninety-nine volumes, embracing a total of more than 79,000 pages of printed matter, have been issued.

The executive committee of the Carnegie Trust for the Universities of Scotland has submitted to the trustees its report on the administration of the trust for the year 1914–15.

Under the third quinquennial scheme of distribution, which came into operation on October 1, 1913, a sum of 203,250*l.*, or 40,650*l.* per annum, was allocated among the Scottish universities and colleges. Of this sum 21,250*l.* was applicable towards providing books, etc., for libraries; 160,750*l.* towards the cost of new buildings and of permanent equipment; while 21,250*l.* was assigned towards endowments for lectureships and other general purposes.

The operations of the trust under the research scheme were affected considerably by the war, though the expenditure for the year under the scheme reached 6957*l.* During the year six fellows and nine scholars were engaged on military duty, and in these cases the fellowship or scholarship has been kept open in case the recipient should be able subsequently to resume research work. Notwithstanding adverse conditions, the experts have been able to report favourably upon the work accomplished during the year.

For the academic year 1915–16, seventeen fellowships and thirty-three scholarships were awarded, and fifty-three grants were made. Four of these fellowships and nine of the scholarships were awarded to graduates who are at present engaged on military duty, and they, too, are being held over in the hope that the holders may be able to take up their research work again at a later date.

In the laboratory of the Royal College of Physicians the effect of the war has also been felt, and the ordinary activities have to a large extent given place to special work adapted to the circumstances of the time.

During 1914–15 the expenditure of the trust on assistance in payment of class fees has been further diminished by the war, which has depleted the Scottish universities of so many of their students. As compared with a sum of 41,789*l.*, which was paid on behalf of 3901 individual beneficiaries for 1913–14, the expenditure for the year under review was 33,847*l.* on behalf of 3246 individual students. During the year a sum of 704*l.* was voluntarily refunded by or on behalf of eighteen beneficiaries for whom class fees had been paid by the trust. This is the largest sum yet received in this way in any one year.

The report is provided with four appendices dealing respectively with: the grants to universities and colleges, the post-graduate study and research work done by the fellows and scholars, the amount of the assistance rendered to students, and an abstract of the financial account for the year. The list of publications by fellows, scholars, and grantees received by the committee during the year runs to about six pages, and an examination of it shows that very many branches of science have derived benefit from the trust, which is being admirably administered.

THE SUPPORT OF THE HIMALAYA.[1]

THE major prominences of the earth's surface are in some way compensated by a defect of density underlying them, with the result that they do not exert the attractive force, either in a vertical or in a horizontal direction, which should result from their mass. A study of the distribution of this compensation shows that there is a general balance between it and the topography, such that the weight of any vertical column through the crust of the earth is, on the average, constant, whatever may be the elevation of the surface. To this condition the term isostasy has been applied, which does not merely denote a static condition, but implies a power of adjustment of the compensation to the variation in load produced by surface-denudation and transport.

1 Abstract of a lecture delivered before the Geological Society of London on February 2 by Mr. R. D. Oldham, F.R.S.

The explanations that have been proposed of the existence of compensation fall into two classes. One supposes the relief of the surface to be due to an alteration in the volume of the underlying rock, and may be regarded as hypotheses of tumefaction. They involve no addition of matter to the crust under a mountain-range, and do not provide, either for any departure from a balance between topography and compensation, or for a restoration of the balance when disturbed by denudation. The other group of hypotheses attributes the origin of the range to a compression of the crust, the injection of molten matter, or the "undertow" of the lower part of the crust. To provide for compensation any hypothesis of this class will require a downward protuberance of the nether surface of the crust, causing a displacement of denser by lighter material, as also an effect of buoyancy owing to this difference of density: this group of hypotheses, therefore, may be regarded as one of support by flotation. They involve a migration of matter from outside to beneath the range, they allow of a considerable local departure from exact balance between load and support (or topography and compensation), so long as the defect in one tract is balanced by an excess in an adjoining one, and they provide for an adjustment of any disturbance of this balance.

The geodetic observations in the Himalayas show that there is a defect of compensation in the outer hills, which increases in amount until at about 50 miles from the edge of the hills it reaches an equivalent to an overload of about 2000 ft. of rock. In the interior of the Himalayas the only observation yet published shows that at about 140 miles from the edge of the hills this overload has disappeared, and compensation is in excess. The variation in the balance between topography and compensation points to one of the second group of hypotheses, to a support of the range by flotation, and to the conclusion that the growth of the support has been more rapid than that of the range. The primary problem then becomes, not as to how the Himalayas are supported at their actual height, but why they are not even loftier: in other words, the problem is carried one stage farther back, from the origin of the range to the origin of its "root."

This result of the examination of the geodetic data simplifies the explanation of some difficult geological questions. It affords an easy explanation of the indications which are found in the interior of the Himalayas, and of other similar ranges, of simple vertical uplift without disturbance, and also of the manner in which the contorted and faulted strata, the disturbance of which must have taken place under the pressure of some thousands of feet of rock, have been brought up to a level where they are exposed to denudation and their structure revealed; but it brings us very little nearer to an explanation of the ultimate origin of the range. It is a distinct step forward in illustration of the mechanism of the production of mountain-ranges of the type of the Himalayas and the Alps, but we are as far as ever from an understanding of the power by which this mechanism is driven.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Huxley Lecture is to be delivered on Friday, March 10, by the Right Hon. the Viscount Bryce, who has chosen as his subject, "War and Progress: an Inquiry from History of how far War and Peace have respectively contributed to the Progress of Mankind."

OXFORD.—On March 7 the statute providing for the introduction of research in the honour school of chemistry was promulgated in Congregation. The adoption of the statute, which had received the support of every teacher of chemistry in the University, was warmly advocated by the Rev. G. B. Cronshaw, fellow of Queen's College, who spoke especially of the educational aspect of the proposed change, and by the Waynflete professor of chemistry (Prof. Perkin), who urged that Oxford should lead the way in a matter of pressing national concern. Similar changes were foreshadowed in the physiology and other natural science examinations. The preamble of the statute was approved without a division.

CORNELL UNIVERSITY has recently suffered the loss of its valuable chemical laboratories, housed in Morse Hall, which has been destroyed by fire. The damage, estimated at 60,000*l.*, is partly covered by insurance. Fortunately the students were able to remove about 5000 books from the library on the ground floor; platinum worth 400*l.* and radium worth 200*l.* were also saved.

WE learn from the issue of *Science* for February 18 that the U.S. General Education Board has announced the following grants to American colleges:—Maryville College, Maryville, Tennessee, 15,000*l.* toward an endowment fund of 60,000*l.*; Western College for Women, Oxford, 20,000*l.*, toward an endowment fund of 100,000*l.*; Milwaukee-Downer College for Women, Milwaukee, Wisconsin, 20,000*l.*, toward an endowment fund of 100,000*l.* Including the foregoing, the General Education Board has since its organisation thirteen years ago appropriated to colleges 2,464,492*l.* toward a total sum of 11,475,105*l.* to be raised. Our contemporary also states that the board of trustees of the Carnegie Institute, Pittsburgh, announces the gift of 50,000*l.* from the Carnegie Corporation of New York, the money to be used for the purchase of ground north of the present campus.

AT a meeting held in Paris in April, 1914, the International Commission on Mathematical Teaching decided to undertake an inquiry regarding the preparation, both academic and practical, of teachers of mathematics in various countries. The continuation of this inquiry has naturally been checked by the present war; at the same time, it is hoped that the various national sub-commissions will continue their work at least so far as the preliminaries are concerned. For this purpose a series of questions in English, French, Italian, and German has been drawn up under the editorship of M. H. Fehr, from whom it may be obtained (address 110 Route de Florissant, Geneva). The replies were to be sent to Prof. Gino Loria, 41 Piazza Manin, Genoa. Most of the questions are evidently suggested by conditions differing widely from those which prevail in Great Britain.

THE issue of *Science* for February 18 gives the following particulars as to numbers of students in attendance at German universities and technical schools from a report by the Berlin correspondent of the Journal of the American Medical Association:—During the semester preceding the opening of the war 79,077 students (of whom 4500 were women and about 9000 foreigners) attended the fifty-two universities and other higher institutions of the German Empire. Of this number 60,943 (4,117 women, 4,100 foreigners) were enrolled in the twenty-one universities; 12,232 (82 women, 2500 foreigners) were enrolled in the eleven technical schools. The six schools of commerce (Berlin, Cologne, Frankfort, Leipzig, Mannheim, and Munich) had 2625 students, and the four veterinary colleges (Berlin, Dresden, Hanover, and Munich) had

1404 students. The three agricultural colleges had 938 students. Three schools of mining had 668 students, and 267 students were registered in the four schools of forestry. During the first semester following the beginning of the war, the total number of matriculants fell to 64,700 in forty-seven of these institutions. The four schools of forestry were closed, and the veterinary school in Munich became a part of the University. During the winter of 1914–15 about 50,000 of these students were in the field or available for service; that is, 75·75 per cent. of the 66,000 German male students registered at the beginning of the war. Of the 66,000 German male students who were registered at the end of the summer of 1915, only 12,000 are still in attendance at the schools, so that about 54,000, or 81·81 per cent., of German higher students are now enrolled in the army. Of the 13,785 university students registered during the summer semester of 1870, only 4400 (32 per cent.) were at the front, and 3200 of this number fell in the field.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 24.—Sir J. J. Thomson, president, in the chair.—Prof. Karl **Pearson**: Mathematical contributions to the theory of evolution. XIX.—Second supplement to a memoir on skew variation. This memoir adds certain additional types of frequency curves to those published by the author in memoirs in the *Phil. Trans.* of 1895 and 1901. It sums up by aid of a diagram the old results and the present additions. It further illustrates by an important general case that frequency curves are distributed over a wide area of the β_1, β_2, plane, where β_1, β_2 are fundamental statistical constants, and that only evil can arise from inflating the Gaussian point ($\beta_1=0$, $\beta_2=3$) to cover the whole of this area. The entire subject is, in the author's opinion, of much importance, as significant differences are in many branches of science determined by the so-called "probable error," of the measured quantities, whether they be means, standard deviations, or correlations. But such "probable errors" have little, if any, meaning, if it can be shown that the sample value is not even the most probable value of the statistical constant in the sampled population, and that the samples are not distributed in a form in the least approaching the Gaussian distribution about the mean value of samples. In every case it is needful to determine the actual frequency distribution, and in nine cases out of ten in samples such as are in common use in psychology, astronomy, or physics—what the statistician terms small samples—it is easy to demonstrate that the distribution is very far from the Gaussian type, but may be markedly skew to such an extent that the ordinary "probable error" is meaningless.—F. P. **Burt** and E. C. **Edgar**: The relative combining volumes of hydrogen and oxygen. The gases were measured successively in a constant-pressure pipette at 0° C. and 760 mm. pressure. (i) In the first series hydrogen and oxygen were prepared by electrolysis of barium hydroxide solution. The hydrogen was purified by passage over charcoal cooled in liquid air; the oxygen by liquefaction and fractionation. Mean value for ratio of combining volumes from twelve experiments was 2·00294. The figure 2·00288 is adopted as final value for ratio of combining volumes at 0° C. and 760 mm. pressure. This differs from the value of Scott (2·00285) by only 3 parts in 200,000. The resulting atomic weight for hydrogen (O=16) computed from Morley's value for the density ratio (0·089873/1·42900) is 1·00772, very nearly the arithmetic mean of Morley's and Noges's values (1·00762 and 1·00787).—W. **Mason**: Speed effect and recovery in slow-speed alternating stress tests. Repeated cycles of equal direct and reverse torque have been applied to mild steel specimens of tubular form, and systematic measurements made of the range of the corresponding torsional strains. The author attempts to account for variations of strain on the hypothesis of alternate production and hardening of "mobile material" in the steel.—W. M. **Thornton**: The ignition of gases by impulsive electrical discharge. The ignition of gases by impulsive discharge is considered first as a function of sparking distance. It is shown that the shorter the distance the greater the spark, so that the volumes of the least igniting sparks are, in a typical case, the same for all spark lengths. Ignition may occur with intense momentary brush discharge, generally with the true disruptive spark. The products of combustion are found to be ionised and to carry a positive charge. The gases examined were mixtures in air of hydrogen, methane, propane, and pentane; of ethylene and acetylene; carbon monoxide and cyanogen; coal gas and a mixture of equal volumes of hydrogen and methane. Hydrogen, propane, pentane, and carbon monoxide rise gradually in difficulty as the percentage of oxygen is reduced; methane is ignited by the same spark whatever the percentage of gas may be; acetylene and cyanogen have the stepped atomic type of ignition; ethylene is more inflammable in rich mixture. Hydrogen and methane in equal volumes are ignited as methane in type, hydrogen in magnitude.

March 2.—Sir J. J. Thomson, president, in the chair.—J. B. **Cohen**, H. D. **Dakin**, M. **Daufresne**, and J. **Kenyon**: The antiseptic action of substances of the chloroamine group. The probability that the formation from proteins of substances containing halogen was an intermediate agent in the germicidal action of hypochlorites made it desirable to investigate systematically a number of substances containing the (NCl) group. Among the substances investigated, the most promising were the group of sulphochloroamides first prepared by Chattaway. The following are the main results of this investigation:—(1) almost all the substances examined containing the (NCl) group possessed very strong germicidal action. (2) The presence in the molecule of more than one (NCl) group does not confer any marked increase in germicidal power. (3) The germicidal action of many of these chloroamine compounds is molecule for molecule greater than that of sodium hypochlorite. (4) Substitution in the nucleus of aromatic chloroamines by Cl, Br, I, Ch_3, C_2H_5, or NO_2 groups does not lead to any very great increase in germicidal activity. More commonly there is a moderate diminution. (5) The chloroamine derivatives of naphthalene and other dicyclic compounds of sulphochloroamide type closely resemble simpler aromatic chloroamines in germicidal action. (6) The few bromoamines examined show a slightly lower germicidal action than the corresponding chloroamines, but sodium sulphobromoamides are much more active than sodium hypobromite. (7) Derivatives of proteins prepared by the action of sodium hypochlorite and containing (NCl) groups are strongly germicidal. Blood serum inhibits their germicidal action to much the same extent as it does with sodium hypochlorite or the aromatic chloroamines. Among the above products p-toluene sodium sulphochloroamide was selected as being on the whole most suitable for practical use. It is easily and cheaply made; it is relatively non-irritating to wounds; it is non-toxic and very soluble in water, and may be kept unchanged, both in the solid state and in solution for a long period.—I. J. B. **Sollas** and Prof. W. J. **Sollas**: The structure of the Dicynodont skull. This is an account of a skull of Oudenodon studied in serial transverse sections. T

supplements and confirms the author's previous description of the skull of a Dicynodon. (*Phil Trans.*, B., vol. cciv., 1913).—W. L. **Balls**: Analyses of agricultural yield. Part iii.—The influence of natural environmental factors upon the yield of Egyptian cotton. A discussion is given of all existing data for the behaviour of the Egyptian cotton crop under the conditions of field cultivation during five years as analysed by the author's method of plant-development curves. The term pre-determination is given to the fact that a fluctuation may be due to causes acting at some date long prior to its visible appearance. Thus daily fluctuations in rate of flowering are due to environmental conditions existing a month beforehand. Many other reactions of crop to environment are inexplicable unless allowance is made for pre-determination. It is shown that there is no factor of "season" as such. The action of such factors as weather and climate, soil-water and soil-fertility, are differentiated and traced in the various curves. The predominant influence of an autumnal rise of water-table in determining yield of crop is indicated, and the sensitivity of the plant to root-asphyxiation is shown. A discussion of the function of the root-system, and of the importance of the factors operating through it, is made possible by the nature of the data. The factor of varietal constitution is shown to be of relatively insignificant importance, as compared with environmental factors, in determining yield of crop. The results of these three analyses show that yield of crop can be studied physiologically as yield of an average plant by statistical records of development, and these can be satisfactorily interpreted in terms of the limiting factors of environment, reacting upon inherited genetic properties of plant, provided that the phenomenon of predetermination is taken into account.—A. J. **Ewart**: The function of chlorophyll, carotin, and xanthophyll. In the assimilation of carbon dioxide chlorophyll acts as a light energising enzyme. It takes direct part in the cycle of chemical changes which have xanthophyll as an intermediate product, and glucose, levulose, formaldehyde, and oxygen as end products. Most of the sugar is formed directly and not through the medium of formaldehyde. A large part of the energy represented by this sugar is absorbed during the reconstruction of the chlorophyll molecule. Apart from its protective function, carotin seems to be especially important as providing, during its photo-oxidation, the massive hydrocarbon combination in the phytyl radicle of chlorophyll, the addition of which is necessary to convert the dicarboxylic glaucophyllin into the tricarboxylic chlorophyll. Carotin and xanthophyll are mutually transformable by the aid of metallic oxydases and reductases respectively. Oxidation in darkness is not necessarily the same as that taking place in light. An emulsion of carotin in light in the presence of copper sulphate and salt develops reducing sugar and formaldehyde, whereas in darkness, although slowly oxidised, no sugar or formaldehyde is produced. The oxidation of chlorophyll, carotin, and xanthophyll is more rapid at high temperatures than at low ones.

Zoological Society, February 22.—Dr. A. Smith Woodward, vice-president, in the chair.—B. F. **Cummings**: Report on a collection of Anoplura and Mallophaga obtained from animals in the society's gardens. The author dealt with the structure and development of the various species, and gave descriptions of three new forms.—Dr. P. Chalmers **Mitchell**: Further observations on the intestinal tract of mammals.

CAMBRIDGE.

Philosophical Society, February 21.—Prof. Newall, president, in the chair.—Dr. **Doncaster**: Some gynandromorphic specimens of *Abraxas grossulariata*. In 1915 two specimens of *A. grossulariata* were bred which showed a mixture of male and female characters. Both were from matings of *grossulariata* female by *lacticolor* male. The specimen which was predominantly male was *lacticolor*, although only *grossulariata* males are expected from this mating, and the predominantly female specimen was *grossulariata*, where *lacticolor* females are expected. Reason was given for supposing that previously reported exceptions to sex-limited transmission may have been to some extent gynandromorphic.—L. **Harrison**: A preliminary account of the structure of the mouth-parts in the body-louse. The stomatodæum of Pediculus comprises a buccal cavity, pumping-pharynx, pharynx, and œsophagus. Upon the floor of the buccal cavity opens a long diverticulum, containing two piercing stylets and a chitinous salivary duct. A hitherto undescribed structure, the buccal tube, formed of two apposable half-tubes rising from the floor of the buccal cavity at its junction with the pumping-pharynx, carries blood to the latter. It is suggested that this buccal tube and the whole of the piercing apparatus are derived by modification of the Mallophagan hypopharynx, and that the Anoplura have no close affinity with the Rhynchota.—E. H. **Neville**: The field and the cordon of a plane set of points.

PARIS.

Academy of Sciences, February 21.—MM. Ed. Perrier and d'Arsonval in the chair.—L. **Maquenne**: The presence of reducing substances in commercial sugars other than invert-sugar. It is shown that known quantities of invert-sugar added to pure cane-sugar can be accurately determined by the methods described by the author in previous communications, working either at 65° C. or 100° C. On the other hand, commercial sugars, both crude and refined, show appreciable differences in the invert-sugar obtained from analysis at these two temperatures, and this is held to be due to the presence of other reducing substances.—Pierre **Duhem**: The electrodynamics of dielectric media.—A. **Khintchine**: An extension of Denjoy's integral.—Ed. **Sarasin** and Th. **Tommasina**: Study of the Volta effect by induced radio-activity: proof of two new facts. It is established that, either in the case of electrodes separated by air containing emanations and the radiations of induced radio-activity, or in that where the electrodes (of different metals) are in direct contact, but in contact also with induced radio-activities and always under the influence of an electrostatic charge, there is a production of current. The radio-active medium in these experiments behaves similarly to the electrolyte of a battery.—Thadée **Peczalski**: The law of integral radiation and the yield of light of metals at high temperatures. The law of integral radiation of tantalum is found by experiment to be $E = \sigma T^{4.2}$. Graphite sensibly follows Stefan's law; and its emissive power corresponds to that of a black body.—C. **Benedicks**: A new thermo-electric method for the study of the allotropy of iron and other metals. The wire under examination is moved at a constant velocity (1·6 mm. per second) through a small electric furnace maintained at a constant known temperature, and measurements made of the electromotive forces developed. Iron shows clearly the point A_3, but no discontinuity was found for the point A_2.—Léon **Bérard** and Auguste **Lumière**: Retarded tetanus. Commenting on a recent note on this subject by M. P. Bazy, the authors have noticed cases of tetanus developing 84, 90, and 102 days after the wound. It is recommended that a fresh dose of antitetanus serum should be administered every time a surgical operation is made, as such an operation may provoke the liberation of septic products latent in the suspected wounds.

—C. **Houlbert** and C. **Galaine**: The causes of inclusion of foreign material (*chambrage*) in oysters. This phenomenon is caused by a deficiency of organic nutriment, and means are suggested for dealing with oyster-beds to prevent its occurrence.

BOOKS RECEIVED.

The Carnegie United Kingdom Trust. Second Annual Report. Pp. 73. (Edinburgh: T. and A. Constable.)

Year Book of the Royal Society, 1916. Pp. 238. (London: Harrison and Sons.) 5*s*.

Carnegie Institution of Washington. Year Book, No. 14, 1915. Pp. xii+429. (Washington: Carnegie Institution.)

Psychological Effects of Alcohol. By R. Dodge and F. G. Benedict. Pp. 281. (Washington: Carnegie Institution.)

Ptolemy's Catalogue of Stars: A Revision of the Almagest. By Dr. C. H. F. Peters and E. B. Knobel. Pp. iii+207. (Washington: Carnegie Institution.)

Rural Arithmetic. By A. G. Ruston. Pp. xi+431. (London: University Tutorial Press, Ltd.) 3*s*. 6*d*.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, 1915. Pp. vi+351. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*. net.

A Text Book of Geology. Part i. Physical Geology. By Prof. L. V. Pirsson. Pp. vii+444. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. net.

Analytic Geometry. By Dr. H. B. Phillips. Pp. vii+197. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

Mathematical Monographs. No. 16. Diophantine Analysis. By R. D. Carmichael. Pp. vi+118. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY MARCH 9.

ROYAL SOCIETY, at 4.30.—The Distribution of Intensity in Broadened Spectrum Lines: Prof. J. W. Nicholson and T. R. Merton.—Prof. Joly's Method of avoiding Collision at Sea: Prof. H. C. Plummer.—Apparatus for the Determination of Gravity at Sea: Prof. W. G. Duffield.

ROYAL INSTITUTION, at 3.—Recent Excavations in Mesopotamia—The Southern Capital. Babylon: Prof. L. W. King.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Continuous-current Railway Motors: E. V. Pannell.

OPTICAL SOCIETY, at 8. -A Simple Focometer for the Determination of Short Focal Lengths both Negative and Positive: T. F. Connolly.—The Manufacture and Testing of Prismatic and other Compasses: F. E. Smith.

MATHEMATICAL SOCIETY, at 5.30.—Some Applications of General Theorems of Combinatory Analysis: Major P. A. Macmahon.—Mr. Grace's Theorem on Six Lines with a Common Transversal: Prof H. F. Baker.—The Integrals of a certain Riccati Equation connected with Halphen's Transformation: H. E. J. Curzon.—A Certain Plane Sextic: Miss Hilda P. Hudson.—The Construction of Co-apolar Triads on a Cubic Curve: Dr. W. P. Milne.—The Dynamical Equations of the Tides: J. Bondman.

FRIDAY, MARCH 10.

ROYAL INSTITUTION, at 5.30.—Illusions of the Upper Air: Sir Napier Shaw.

ROYAL ASTRONOMICAL SOCIETY, at 5.—General Solution of Hill's Equation: E. Lindsay Ince.—Distribution of Star Clusters: O. R. Walkey.—Mean Areas and Heliographic Latitudes of Sun-spots in 1914: Royal Observatory, Greenwich.—Remarks on the Formation of Sun-spots: F. Henroteau.—Calculation of Longitude from Moon and Moon-culminating Stars: F. J. Broadbent.—Observations of Jupiter: F. Sargent.—Statistics of Minor Planets H. C. Plummer.—Faint Stars with large Proper Motions (ninth note) F. I. Pocock.—Longitudes of Jupiter's Satellites: W de Sitter.—*Probable Papers:* The Nature of the Coronium Atom: J. W. Nicholson.—The Eclipsing Binary T T Aurigæ: C. Martin and H. C. Plummer.—Note on Bright Meteors: H. C. Plummer.—Baxendell's Observations of Variable Stars, T. Herculis: H H. Turner and M. A. Blagg.

PHYSICAL SOCIETY, at 5.—Experiments Illustrating the Flow of Heat in Conducting Sheets: S. Skinner.—The Absorption of Gas by a Quartz Vacuum Tube: Dr. R. S. Willows and H. T. George.

SATURDAY, MARCH 11.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

TUESDAY, MARCH 14.

ROYAL INSTITUTION, at 3.—Sea Power as a Factor in the Evolution of Modern Races: Prof. A. Keith.

WEDNESDAY, MARCH 15.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Meteorology of the Globe in 1911: Sir Napier Shaw.

ROYAL SOCIETY OF ARTS at 4.30.—Forestry and the War: E. P. Stebbing.

FARADAY SOCIETY, at 8.—Discussion on Methods and Appliances for the Attainment of High Temperatures in the Laboratory. Opener: Dr J. A. Harker.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Original Factors in Evolution. Prof. J. Arthur Thomson.—The Supposed Exhibition of Purpose and Intelligence by the Foraminifera: Sir E. Ray Lankester.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, MARCH 16.

ROYAL INSTITUTION, at 3.—Organic Products used as Propulsive and Explosive Agents: Prof. H. E Armstrong.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Possibilities in the Design of Continuous-current Traction Motors: N. W. Storer.—The Use of Direct Current for Terminal and Trunk Line Electrification: N. W. Storer.

LINNEAN SOCIETY, at 5.—Resemblance between African Butterflies of the genus Charaxes; a New Form of Mimicry: Prof. E. B. Poulton.—Notes on Plants collected in Sikkim, including the Kalimpong district: C. C. Lacaita.—Exhibition of Species of Ribes and their Garden Derivation: E. Bunyard.—Early Botanical Exploration of North America: B. Daydon Jackson.

CHILD STUDY SOCIETY, at 6.—The Unconscious Mental Life of the Child: Dr. E. Jones.

FRIDAY, MARCH 17.

ROYAL INSTITUTION, at 5.30. —The Search for New Coal Fields in England: Dr. A. Strahan.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Composition of the Exhaust from Liquid-fuel Engines: R. W. Fenning.

SATURDAY, MARCH 18.

ROYAL INSTITUTION, at 3.—Radiation from Atoms and Electrons: Sir J. J. Thomson.

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THURSDAY, MARCH 16, 1916.

LONDON HYDROLOGY.

Old London's Spas, Baths, and Wells. By Dr. S. Sunderland. Pp. xii+169. (London: John Bale, Sons, and Danielsson, Ltd., 1915.) Price 7*s.* 6*d.* net.

A LARGE number of springs in London have been closed (in recent years) in order to pro-ect the public from the risks of water-borne naladies. Some, like the famous Broad Street Pump, at the time of the cholera epidemic in 1854, iave been proved to be the active distributors of lisease. But it may be questioned whether in the vholesale closing of the London wells the innocent iave not suffered with the guilty. It is sometimes orgotten that the change in water-supply gener-illy signifies the substitution of *mixed* waters for he water of a single source. It is at least open o question whether, from the point of view of iealth, fresh drinking water from a single source s not to be preferred to mixed waters of what-ever purity.

In this attractive book Dr. Sunderland states hat in 1866 people in the City of London had iccess to thirty-five public pumps, all now closed. Many other districts of the great London basin, uch as Clerkenwell, were rich in springs. All hese particular sources have been abolished with lrastic thoroughness in order to avoid the danger of possible contamination. In return, under a "Water Board," London enjoys the blessing so iptly described by an astonished visitor from a vaterless country in the East as a "spring in very house." But now the Londoner drinks ot water, but waters.

The present volume originated in the author's residential address before the section of the Royal Society of Medicine which is concerned vith the medical aspects of waters and climates. t gives the best account yet published of the prings of old London, especially of those—sur-risingly numerous—which have been at various imes medically employed. No fewer than thirty iedicinal springs "of slight importance" in and ear London are described, all of which were oubtless esteemed for curative properties by the eople in their localities, whether for drinking or athing. The chalybeate springs form everywhere ie largest class of mineralised waters, and many f this kind in London were applied locally for ieir astringent properties, like the "Eye Vaters" of Highgate and of the St. Anne's Well n Hyde Park. This popular recourse and attachment to waters for common ailments belongs, as we know, to all times and to all places, but in London it has been in our own day finally extinguished by the zeal of the sanitarian.

A wider importance attached to the old London spas—medicinal springs which from merit or accident acquired a considerable reputation in the town, and became in consequence, in varying degrees, fashionable health and pleasure resorts. The author traces the history and character of these spas, some of which were "spurious" and others "genuine" and medically valuable. He gives particulars of twenty situated north of the Thames, and eight of these were within a mile of King's Cross. It is interesting to note that one of these, the Islington Spa, was under Royal favour much frequented, as many as sixteen hundred persons drinking the water in one morning. Another notable northern spa was that of Hampstead. It took origin in the seventeenth century, and was a true health resort—offering a tonic water in a tonic air. Perhaps the chief among the spas of London, possessed of real medical value, Hampstead fell a victim to the great malady of health resorts—the unbridled appetite for pleasure. "It is reasonable to believe," says Dr. Sunderland, speaking of another London resort, "that the beneficial effect of the tonic water was counterbalanced by the feastings, just as in the present day some of the good effects of the British and foreign spas frequented by the richer classes are annulled by the high living at the magnificent hotels where some of the visitors stay."

South of the Thames there were thirteen spas, including Richmond, Epsom, and Shooter's Hill, which were really country health resorts. We are told that Streatham is the "only one of the old London spas where the waters can be drunk at the present day with beneficial effect." This mild medicinal water was formerly much frequented and esteemed by competent authority.

It is appropriate that this forgotten chapter in British hydrology should be recalled now. The brief but golden age of the London spas ceased with the rise of others further from the capital. Leamington, Cheltenham, Bath, Tunbridge Wells came into favour, and some of these in their turn have paled before the glories of more remote attractions. It is the old story of the lure of the unknown, of the "distant and the far." But conditions now are different. It must be remembered that an exact knowledge of the actions and uses of waters has only been made available in the present generation. Thanks to an accurate study

of hydrological medicine, these natural remedial agents can now be prescribed with authority and precision, and presently it will be as foolish to go to the wrong spa as to choose an inappropriate drug or an improper operation in surgery.

For the necessary growth of this knowledge research and instruction must go hand in hand. At the present time, as Dr. Sunderland points out, the value of waters and baths scientifically applied is being abundantly proved in the case of sick and wounded soldiers. The results obtained at the British spas show how great and unexpected are the resources of our own country in this respect.

That which is wanting in British hydrology is system—both in scientific teaching and in co-ordinating the unrivalled assets belonging to the health resorts of the Empire. It remains for London to meet this need by providing the means of special instruction and research. Here as elsewhere in medicine the tradition and empiricism of the past must in due course give place to ordered knowledge and instructed art.

Dr. Sunderland's book is profusely illustrated and withal entertaining, and may be recommended to all who are interested in the social as well as the medical history of London.

ORGANIC CHEMISTRY.

Organic Chemistry, or Chemistry of the Carbon Compounds. By Victor von Richter. Volume i. *Chemistry of the Aliphatic Series.* Newly translated and revised from the German edition by Dr. P. E. Spielmann. Pp. xvi+719. (London: Kegan Paul and Co., Ltd., 1915.) Price 21*s.* net.

No more striking illustration of the development of organic chemistry could be found than that presented by the growth of this popular German treatise. Appearing about 1880, as companion volume to a modest octavo text-book on inorganic chemistry, it rapidly acquired popularity and passed through numerous editions. As the contents swelled with each succeeding edition, it became necessary first to divide the book into two parts and finally to modify the format. Like many German scientific books it soon found an American translator and publisher, and has reached its third American edition. The present volume, it should be noted, is the first *English* edition, a term which we presume refers to the nationality of the publisher rather than to the greater purity of the vernacular of the last translator. Be that as it may, Richter's organic chemistry has passed out of the region of text-books.

The theoretical part is condensed into a comparatively few pages at the beginning of the volume, and is of so sketchy and superficial a character as to possess little value for the student. Yet the subject, especially on the physical side in connection with structural problems, is one of growing interest and importance. This is a cardinal defect. On the other hand, the book is so crowded with facts as to form a kind of abridged "Beilstein." It is divided into chapters containing the names of a large number of related compounds, an outline of the mode of their preparation, and an account of their more important physical and chemical properties. Occasionally there is a proper name attached to a compound or process, and sometimes a reference. It is rarely that one finds an English name, or, indeed, that of any other nationality than German. There is no reference to the modern method for preparing silicon alkyl compounds or to its author; no reference to the discoverer of oxalyl chloride, ketene, and the numerous azoimides, or to the mechanism of the formation of formic acid from glycerol and oxalic acid, though the process is given, or to the abnormal addition of bromine to maleic acid, which is wrongly described.

English names, it appears from the preface, are purposely omitted for the remarkable reason that "references to German literature have been retained with the object of preserving to the student the advantages of the origin of the book; the English references will be otherwise readily obtainable by him." If the references are not given, nor even the names of authors of these fundamental discoveries, it is difficult to see how they will be "readily obtainable." No doubt there are advantages in having the origin of the book steadily thrust upon one as a stimulus to the British chemist; but it is to be hoped that there may be forthcoming a text-book—a real students' text-book—of organic chemistry which shall give him a clear, critical, and suggestive review of the big problems of organic chemistry with which the names of many distinguished English chemists are linked. That the English organic chemist has pursued the experimental part of the subject with the object of elucidating theoretical rather than practical problems is readily explained by the fact that his activities on the industrial side have been necessarily restricted, and he has had little incentive up to the present to busy himself with the discovery of new classes of commercially useful products.

J. B. C.

THE ELEMENTARY PRINCIPLES OF CROP PRODUCTION.

(1) *A Student's Book on Soils and Manures.* By Dr. E. J. Russell. Pp. ix+206. (Cambridge: At the University Press, 1915.) Price 3s. 6d. net.

(2) *Soils and Plant Life as Related to Agriculture.* By Prof. J. C. Cunningham and W. H. Lancelot. Pp. xx+348. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 5s. net.

(1) IN the past the "Farm Institute" has been very inadequately represented in our system of agricultural education, but of late much has been done to remedy this defect, and, but for the outbreak of war, more would by now have been accomplished. This type of institution is designed to serve primarily the needs of the country youth whose general education is inadequate for the more advanced courses of the universities and agricultural colleges. The common type of "farm institute" student will thus be the youth whose previous education has been restricted to the curriculum of the rural elementary school with, in most cases, an intervening period of practical work on the farm.

It is for such students that the series of text-books, of which Dr. Russell's volume is the latest issue, is primarily intended, and by the standard of their capabilities it must be judged. It is not clear just in what way Dr. Russell intends his book to be used. In scope and general mode of presentation it may well serve as a pattern for the teacher, but in the hands of the average "farm institute" student we fear that, without considerable assistance from the teacher, much of it will be rather difficult reading. The fault lies probably not so much with Dr. Russell, who has sacrificed nothing in clearness and attractiveness of presentation, as with the limitations of space imposed upon him, which have necessitated a measure of condensation which is undesirable in all elementary text-books, and in none more so than in those provided for the agricultural student.

For its refreshingly unorthodox and suggestive treatment of a well-worn subject, the book is highly to be commended. An excellent feature is the freedom with which the results of experiments made in this country have been drawn upon for the purposes of exposition. The Rothamsted experiments naturally have been chiefly drawn upon, but the useful work done elsewhere is more adequately represented than in any other text-book. The book is printed in attractive type, is freely illustrated with photographs and diagrams, and, apart from one or two obvious slips, leaves nothing to be desired in precision.

(2) In so far as they cover the same ground, the treatment of the subject by Messrs. Cunningham and Lancelot differs widely from that of Dr. Russell. In their "first study in agriculture for rural, grade, and high schools, based upon sound educational principles," they adopt throughout the didactic method which postulates at each stage the approach to knowledge through individual experimental inquiry. The student is led by easy and connected stages through the study of the origin, nature, and functions of the soil, to the study of the outstanding phenomena of plant life, and the application of the knowledge thus gained to the practical problems of crop production.

The numerous exercises in the first half of the book are well designed and practical in their bearing, and are described with a care which must ensure success in the hands of the most inexpert student. It is left to the student to draw his own conclusions, although by leading questions his attention is directed to the essential information which it is desired that he shall acquire.

The method of treatment is quite conventional, but is so well and carefully worked out that the intelligent student cannot fail to acquire a very useful knowledge of the subject. A word of commendation must be given to the photographic illustrations, which are numerous and uniformly good.

The work is intended for the American student, and the exercises and illustrations are largely such as appeal most directly to him, but students and teachers in this country will find much that is useful and suggestive in it.

OUR BOOKSHELF.

Third Appendix to the Sixth Edition of Dana's System of Mineralogy. By Prof. W. E. Ford. Completing the work to 1915. Pp. xiii+87. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 6s. 6d. net.

THE study of mineralogy has received a new stimulus in recent years from discoveries in radioactivity and in the use of X-rays for the exploration of crystal-structure. Just as the determination of optical principles from large and specially selected specimens laid the foundations of microscopic petrography, so these later physical experiments are bound to provide new methods of mineral analysis. While enlarging in the widest sense the bounds of human knowledge, they will reveal the alliances and differences among minerals that bring a philosophic touch into the dry matter of classification. The third appendix to Dana's "System of Mineralogy," drawn up by

Prof. Ford, shows the fresh material available for research, and the progress that has been made through new observations on established species in the last six years. A special list is given of literature on X-rays and crystal structure.

Numerous studies on the thermal behaviour of quartz and on its relations to cristobalite and tridymite come within the period covered by this appendix, and the attention of geologists may well be directed to the references given on p. 66. A cross-reference to these would have been useful under the heads of the other forms of crystalline silica. Among the new species we may note barbierite, which indicates that a monoclinic structure may be formed under certain conditions by the well known felspathic molecule, $NaAlSi_3O_8$. Bazzite, a blue scandium silicate from Baveno, and several vanadium minerals seem attractive novelties. Sefströmite, among the latter, passes away as a mixture. Metallic tantalum, first described in 1909, forms an important record, and specimens have already found their way from the Urals into most collections. It is late to quarrel with the makers of new names, but didymolite, with no didymium, platynolite, suggesting platinum when pronounced, and Prof. Ford's own pyroxmangite for "manganopyroxene," strike us as unfortunate. The author of this appendix, however, will at once be gratefully absolved.

G. A. J. C.

The Structure of the Fowl. By Dr. O. C. Bradley. Pp. xi+153. (London: A. and C. Black, Ltd., 1915.) Price 3*s.* 6*d.* net.

THE author of this little volume has successfully accomplished a somewhat difficult task in his effort to produce a concise and not too elaborate account of the structure of the fowl. The first chapter deals with the zoological position of birds, and includes a very interesting account of the probable ancestry of the domestic fowl. This is followed by chapters on the skeleton and muscular system, both of which are of necessity dealt with in a very elementary fashion. More detail is entered into when the author deals in successive chapters with the digestive system, the respiratory organs, the urinary organs, the reproductive organs, and the circulatory system. The descriptions of the macroscopic characters of these apparatuses are so clear and lucid that they can be well and easily followed by readers who have received little or no previous anatomical training, while the microscopic structure is dealt with in such a masterly way as to render the book of the greatest assistance to the student of comparative histology and pathology. The illustrations in these sections are excellent, and have very considerably simplified the author's task. The nervous system, the eye and its appendages, and the ear are briefly considered, and a chapter is also devoted to the skin and its appendages.

Probably the best chapter is that on the development of the chick, which is dealt with in rather more detail, the various stages being well illustrated.

While this little book would appear to contain little or nothing that is new, it is the only wor with which we are acquainted that contains suc an excellent general description of the structure c the fowl. The illustrations must be regarded as special feature. There are seventy-three of them and many are full-page plates.

There is a very complete index. G. H. W.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible fo opinions expressed by his correspondents. Neithe can he undertake to return, or to correspond wit the writers of, rejected manuscripts intended fo this or any other part of* NATURE. *No notice taken of anonymous communications.*]

The Structure of the Line of Wave-Length 4686 Å.U

PREVIOUS experiments by one of us (NATURE, vo xcii., p. 5; *Phil. Mag.*, vol. xxix., pp. 284–297, 191 have shown that the 4686 line could be obtained b passing a condenser discharge through pure heliun and it was concluded that the results supported theory put forward by Dr. Bohr (*Phil Mag.*, vol. xxvi p. 1, 1913). This theory, which was deduced by apply ing the quantum hypothesis to Sir Ernest Ruthe ford's atom-model, ascribed the line to helium. O the other hand, Rydberg, assuming the Pickerin lines to constitute the sharp series of hydrogen fron analogy with the spectra of the alkali metals, obtaine by calculation the value 4687·88 for the wave-lengt of the first line of the principal series of hydrogen.

The present experiments on the structure of th line were commenced with the purpose of testing sti further its chemical origin, and of obtaining resul which would throw further light on the mechanis of emission of spectrum lines. The importance c accurate knowledge of the structure of hydrogen an helium lines from the latter point of view has alread been shown by Bohr (*Phil. Mag.*, vol. xxix., p. 33 1915). It is well known that the hydrogen lines c the Balmer series are not single lines, but clo doublets, and it is therefore to be expected from bot Rydberg's and Bohr's theories, that the 4686 lin should also have a complex structure. According t Rydberg's theory, the line should be a doublet havin the same frequency difference as the members of th Balmer series. The recent measurements of Buisson an Fabry gave 0·132 Å.U. as the separation of the tw components of Hα, and it follows by calculation th the two components of the 4686 line should b separated by 0·0674 Å.U. From Bohr's theory, th details of the structure of the line could not be antic pated, but from the supposed analogy between th mechanism of emission of the 4686 line and the line of the Balmer series, it was hoped that a knowledg of the structure of the line would serve as a guic in testing different hypotheses for explaining th doubling of the hydrogen lines.

The origin of the "4686" line has recently be studied by Merton (NATURE, vol. xcv., p. 64; Pro Roy. Soc., vol. xci., p. 382, 1915), who used a meth based on Lord Rayleigh's theory of the width spectrum lines. He concluded that either the bread of the line is controlled by circumstances at prese unknown, or that the line originates from systems sub-atomic mass. Later experiments by the san author (Proc. Roy. Soc., vol. xci., p. 421, 191 February, 1916) show that the widths of some spe trum lines are not wholly due to the motion of t molecules.

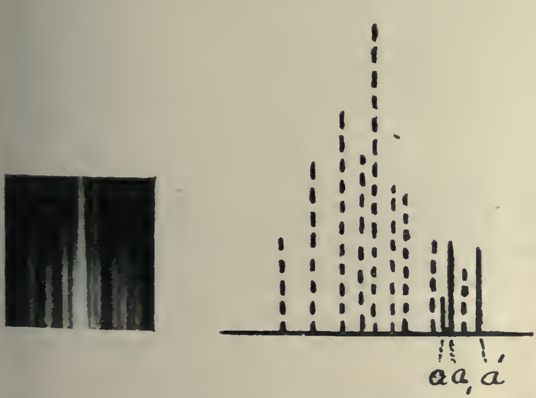
In our first set of experiments the line was excit by passing a condenser discharge through a heliu

tube with an adjustable spark gap in series with it. The structure of the line was studied by means of an echelon spectroscope, consisting of thirty-three glass plates, each plate being 9·48 mm. thick. The resolving power of the instrument at 4686 was 441,421, and the distance between successive orders of the line was 0·350 A.U. The line when excited by a condenser discharge was found to be very broad and diffuse, and two successive orders were only just separated on the best photographs. In some experiments the spectrum tube was immersed in liquid air, but no measurable improvement in the sharpness of the line was obtained. This result may also be expected on Bohr's theory, as the atom is charged when emitting the lines. It was therefore decided to excite the line by means of a direct current, keeping the drop of potential between the anode and kathode as low as possible. The direct-current machine, which was connected through a liquid resistance to the electrodes, could give a voltage of 2000 and an output of one kilowatt. As fairly large currents were passed through the gas the cylindrical spectrum tube was made large, and was also provided with two heavy aluminium electrodes, one of which was concave and the other a hollow cylinder. The tube was used in the end-on position.

It was found that when the cylindrical electrode was made the kathode the light was almost completely confined to the space inside the cylinder, and that it was very intense. Experiments were usually conducted at a pressure of 1 mm., and the voltage between the anode and kathode varied in different experiments between 280 and 400. Under these conditions, although the ordinary helium lines were strong, the 4686 line was comparatively faint, and exposures of about two hours were necessary for obtaining a satisfactory photograph.

The line was found to be surprisingly sharp; in fact, it was comparable in sharpness with the lines of the ordinary helium spectrum, and much sharper than the $H\beta$ line of hydrogen, which was photographed at the same time. In addition, all the photographs showed that the line was a close doublet, the components having almost equal intensity. The best photographs were measured up, and the distance apart of the two components was found to be 0·094 Å.U. It is interesting to note that the separation to be expected on Rydberg's theory is 0·067 Å.U.

The structure of the line is shown in the accompanying photograph, which is explained by the diagram. The dotted lines represent the different orders of the 4713 helium line and its faint component, and the full lines the 4686 line. The doublet is represented by aa_1, and a^1 is a higher order of a.



These experiments were still in progress when there appeared a very interesting theoretical paper by Sommerfeld (*Bay. Akad. d. Wiss.*, Munich, 1916) on the structure of spectrum lines, which was based on a remarkable generalisation of Bohr's theory. In this paper he quotes certain unpublished results of Paschen on the structure of several lines of the series

$$n = k'\left\{\frac{1}{(1\frac{1}{2})^2} - \frac{1}{\left(\frac{n}{2}\right)^2}\right\}$$

the first member of which is the 4686 line, and also of several lines of the series

$$n = k'\left\{\frac{1}{(2)^2} - \frac{1}{\left(\frac{n}{2}\right)^2}\right\}$$

which includes the Pickering lines, and also another series of lines near the hydrogen lines, one member of which, at 6560·4, was first observed by one of us in a helium tube.

In complete agreement with Sommerfeld's theory Paschen found that the 4686 line consisted of three components, each of which was accompanied by fainter satellites, and the two stronger components were separated by a distance one-fourth of that between the outer components. The values of the separations in Ångstrom units as obtained by Paschen are not given in Sommerfeld's paper, but it is stated that the ratios of the separations of the components of the 4686 line to the separations of the components of $H\alpha$ agree with the values predicted by the theory. Our result for the distance between the components of the doublet also agrees approximately with the value predicted by Sommerfeld for the separation of the two strongest components. Since the appearance of the paper we have re-examined all our photographs to see if they show the presence of a third faint component which we had missed. On our best photograph we found near one of the higher orders of the doublet, but not completely separated from it, a faint line. If this line is a lower order of the third component its separation measured from the doublet is about 0·40 Å.U., and it is situated on the higher wave-length side, as is to be expected according to Sommerfeld's theory.

E. J. EVANS.
C. CROXSON.
Manchester University, March 4.

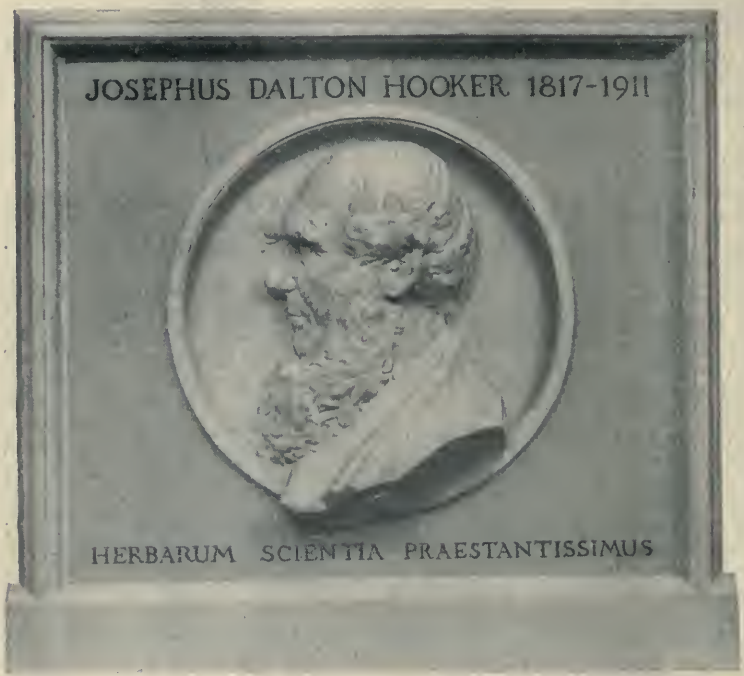
Ground Rainbows.

MR. A. E. HEATH asks (NATURE, March 2, p. 5) how gossamer which "seems to be a kind of spider web, comes to be spread over so large an area." Mr. Heath need have gone no further than Selborne to find the correct explanation, given by Gilbert White 140 years ago:—"Nobody in these days doubts that they (the cobweb-like appearances) are the real production of small spiders which swarm in the fields in fine weather in autumn, and have a power of shooting out webs from their tails so as to render themselves buoyant." Possibly the first part of the sentence was not true when Gilbert White wrote it, seeing that it is not always the case to-day. The thick clouds of gossamer noticed by Mr. N. T. Porter when out shooting in the early morning were noticed also by Gilbert White in September, 1741, when "intent on field diversions I rose before daybreak." If a more recent account of gossamer is preferred it may be found in Fabre's "Life of a Spider."

CHARLES J. P. CAVE.
Meteorological Office, South Farnborough,
March 7.

MEMORIALS OF MEN OF SCIENCE IN WESTMINSTER ABBEY.

IN November last memorial tablets to Sir Joseph Hooker, Lord Lister, and Dr. Alfred Russel Wallace were unveiled in the north aisle of Westminster Abbey. By the courtesy of the Right Rev. the Dean of Westminster, Dr. H. E. Ryle, photographs of these memorials have been taken by the Dean's verger, Mr. D. Weller, and are here reproduced. The limited size of the tablets has prevented the employment of inscriptions other than those upon the accompanying illustrations.



Photo] FIG. 1.—Sir Joseph Hooker tablet in Westminster Abbey. [*D. Weller.*

The memorials were unveiled without any public ceremony, but at the afternoon service of the same day the Dean of Westminster referred to them. He said that Hooker, Lister, and Wallace would always rank among the most eminent men of science of the nineteenth century; and they were all men of a singularly modest character, who worked without regard to recognition.

It may be of interest here to mention some other memorials of men of science in Westminster Abbey. Sir John Herschel and Charles Darwin lie side by side in the nave (north aisle), where also rest the remains of John Hunter, John Woodward, and Sir Charles Lyell, of whom there is a bust. Near Darwin's memorial three other scientific workers are commemorated, J. P. Joule by a tablet, J. C. Adams by a medallion, and Sir George Stokes by a portrait-head. The grave of Newton is before the choir screen, one of the most conspicuous spots in the Abbey, and near it Lord Kelvin was buried. Close by is a memorial window erected to Kelvin. The great statue of James Watt is in the Chapel of St. Paul; and in St. Andrew's Chapel are memorials of Sir Humphry Davy, Thomas Young, and Sir James Simpson. The body of William Spottiswoode lies under the floor of the south transept of the Abbey.

Photo] FIG. 2.—Lord Lister and Dr. A. R. Wallace medallions in Westminster Abbey. [*D. Weller.*

THE REFORM OF THE MAN OF SCIENCE.

SOME correspondence has recently appeared in the *Morning Post* under the title that stands t the head of this article. Lt.-Col. J. W. Barret, f the Australian Army, a Melbourne doctor, well nown for his active participation in the educaional world there, writing respectfully of British nen of science, laments their exclusiveness. They re, he implies, too much dominated by the idea of tudentship; they regard the sphere of science too nuch as that of the laboratory and the academy; hey do not acknowledge brotherhood with men n the greater world, who, in the spirit of enterrise and with the kind of method that prevail in onventional science, are solving great problems f industry, commerce, and national development. nother writer goes further, and would hail as a rother in science the man who elucidates the uthorship of Shakespeare's plays or the techique of an old master.

It is not proposed here to enter upon a discuson of the legitimate use of the term science. We ay be all for brotherhood, but the circumstances life compel us largely to separate into groups r purposes of action, and there can be no real omplaint if the word science is used in a restricted sense for what is perhaps better called atural science. This should not prevent men of ience from recognising their kinship with all ithful workers for the elucidation of truth, in hatever sphere of action.

Let us avoid a controversy about mere words. .-Col. Barret's complaint is a more substantial ne—not one of terminology. It is essentially is, that when operations relating to the forces nature transcend a certain scale they are no nger recognised as science, and that men of ience in the limited sense thus lose a great comnionship and an invaluable link with the greater rld. He gives as an illustration the work of a ilroad president whose operations "involve the acing of towns and even cities in new positions, e reorganisation of the agricultural education of stricts, the estimation of future markets, and her complicated actions involving scientific imaation of the first order."

It is probable that most men of science would adily admit that some solid advantages would gained by having in their camp these great erators, with all their intellectual energy, their terprise, and their influence, and perhaps many uld admit their claim to inclusion. There is doubtedly a tendency for an increased scale of erations to remove a man from the scientific ss if he was once in it, or to prevent his accesn if he did not originally enter through the ual portal. The case may be well illustrated om engineering. A scientifically trained engeer who betakes himself to great problems of gineering, constructing some almost impossible lway or irrigating a whole parched province of dia, seems to be moving away from science. engineer who has acquired such powers witho having received the hall-mark of formal scientific training, will find it hard to get his place acknowledged in the ranks of science.

We may ask, What is really at the bottom of this? Is it merely narrow-mindedness, or is there something more excusable? It is pleasant to think that there may be. Scientific men in their most august society are banded together "for the improvement of natural knowledge." They are by implication a body of students working in the temple of Nature for truth's sake alone, heedless of the world and its rewards. What they garner is their gift to the world: they fill another page in the Revelation that brings men nearer to the angels. Let a man wander into the world with his science as wares to sell for money profit, and he has passed from the true brotherhood. Surely this idea, perhaps here rather fancifully stated, is at the bottom of much of our exclusiveness. It is certainly expressed very often in the privacy of small deliberative councils and in personal intercourse, and it is strongly, though silently, operative in the outer world.

If this were the chief reason for the detachment of men of science we should have to ask whether it be really good and sufficient. That it has elements of good in it, no one would deny. There should be much strength in the union of disinterested people, and the flame of disinterested—that is, unworldly—study is the most sacred light of knowledge. But there is this great fact of history and actuality against an austere brotherhood: natural science has had its roots in the practical avocations of mankind, and from them it has received its chief stimulus. The application of science to the practical arts has not more benefited them than it has benefited science. In this place it is unnecessary to illustrate or amplify the argument. It is therefore not only not unbecoming, but it is vitally necessary that the improvement of natural knowledge should be bound up with solving the problems of the busy world, and the man of science who looks with any kind of disdain on those who are engaged in solving these problems, be they labelled brewer, baker, or candle-stick maker, and be they incidentally making fortunes, is despising his best friends and declaring himself a pedant.

As a matter of fact this disdain does linger. It is the inevitable product of the seminary; it is the fatuity of the cloister, arising, no doubt, from the theological beginnings of our educational system—this notion of keeping science unspotted from the world. It has much to answer for. The neglect of applied science—what is it not meaning now in the fortunes of our nation! It is comfortable for us to blame anyone but ourselves. Have we not long proclaimed the vital importance of science for the service of industry and the State? Industry and the State are doubtless much to blame, but surely no fair-minded person would say that the scientific world is exempt. Rather let us acknowledge that Lt.-Col. Barret is in essence right; the scientific world has been too exclusive; it has not bound itself as much as it might have done to great workers in the world, whose tasks, if not the same, are much akin to those of the

laboratory, men whose sympathies, already scientific, would be strengthened by association and make broad channels for the flow of science into practice.

Scientific men, we must admit, have often no conception of the real environment and problems of the industrialist; of the accumulated store of empirical knowledge from which he must select what is needed; of the skill and design with which he must apply it under the limitations imposed by men, material, and markets. They too often underrate the extent and importance of what may be called technological science and the new horizons that it opens. The technologist is often ignorantly set in the outer courts of learning; he is not quite of the elect, and antipathies arise. How much have we not sacrificed of the acceptance and efficacy of science in industry by offering young men trained in pure science and knowing nothing of manufacture, to employers trained in manufacture and knowing nothing of science, relying wholly on the manufacturer for a most difficult and precarious adjustment?

The management of our applied science has become one of the great problems of the day, and it brings with it great difficulties. Spurious technology is a hateful make-believe that has already wrought much mischief; a man, however scientific, wholly on the make—to use a concise vulgar term for a vulgar condition—is an unedifying spectacle. But it does not follow that because a man is preoccupied with industrial problems he shall lose his scientific virtue or that his achievements, however remunerative, should rank on a lower plane. It is not so difficult to distinguish the genuine from the base among scientific workers wherever they may be engaged.

We must strengthen the bonds between science and industry by something more than an appeal to the pocket. A real sympathy and interest must be created on both sides; we must open our arms wider. Even if we find difficulty in discovering, in this country, the type of railway president described by Lt.-Col. Barret, there are yet many men in our world of industry and in the service of the State who, without any list of scientific memoirs to their name, have yet been potent in the service of science, and would be more potent still if they were brought more into companionship with the scientific world. The Royal Society has the power of admitting to its ranks at the rate of one each year "persons, who in their opinion have either rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society." Here at least is a limited opportunity of doing something towards introducing into the circle of science the sort of men whose influence might help towards bringing about the reform to which we are bidden by a candid friend. In any of the new associations that are contemplated for giving science its right place in our national life we shall surely do well to cast our net widely and to extend our outlook beyond the conventional circumference of what have usually been deemed scientific circles.

SULPHURIC ACID IN AMERICA.[1]

IN what is known as a "professional pape[r] Mr. W. H. Waggaman, of the U.S. Depa[rt]ment of Agriculture, has recently given an accou[nt] of the modes of manufacture of sulphuric ac[id] both by the "chamber" and the "contact" p[ro]cess, with special reference to its production [in] the United States for the manufacture of fer[ti]liser materials. As the paper contains so[me] features of interest with respect to American pra[c]tice, a short account of its contents may not [be] out of place at the present juncture.

The production of sulphuric acid of vario[us] strengths in the United States, according to t[he] latest (1913) figures available is stated to be [as] follows:—

Grades	Quantity tons	Value dollars	Price p[er] ton dollar[s]
50° Baumé	1,643,318 ...	9,212,917 ...	5.61
60° Baumé	509,929 ...	3,202,528 ...	6.28
66° Baumé	797,104 ...	9,282,422 ...	11.65
Other grades	63,158 ...	986,659 ...	15.62
Total and Average...	3,013,509 ...	22,684,526 ...	7.53
Total reduced to 50° B.	3,538,980* ...	22,366,482 ...	6.32

* Exclusive of 22,947 short tons of fuming acid, not convertible, val[ued] at 318.044 dollars.

On comparing these figures with those for t[he] two preceding years it appears that there has be[en] a considerable increase in production of each gra[de] with the exception of those classed under "oth[er] grades," the decrease in which is probably a[c]counted for by the item "fuming acid," whic[h] appears for the first time in the statistics. Pr[e]sumably, therefore, the manufacture of this for[m] of oil of vitriol has only been introduced in[to] America within the last three or four years. [If] account is taken of the fuming acid it is obviou[s] that the production of sulphuric acid has ver[y] largely increased in the United States withi[n] recent years. There can be little doubt that th[e] disturbance in Continental production in cons[e]quence of the war, with its effect on the expo[rt] trade of Germany and Austria in dyes, drugs, an[d] fine chemicals, as well as on a variety of oth[er] finished products in which sulphuric acid plays [a] part, direct or indirect, has given a still great[er] impetus to American manufacture, and h[as] tended to consolidate certain industries and [to] initiate others in the States, to the eventual lo[ss] of the belligerent nations. German manufacture[rs] are now beginning to realise that the suprema[cy] they have hitherto enjoyed in certain branches [of] chemical industry is threatened, and nowhere mo[re] seriously than in America.

American chemists have not talked to anythi[ng] like the same extent as we have done abo[ut] "capturing German trade." Nevertheless, [the] recent discussions in the American Section of t[he] Society of Chemical Industry unmistakably in[di]cate, aided by their elastic fiscal policy, they ha[ve] quietly and deliberately set themselves to do [it]. And, curiously enough, the "hyphenated" Am[e]-

[1] "The Production of Sulphuric Acid and a Proposed New Metho[d of] Manufacture." By W. H. Waggaman. U.S. Department of Agricul[ture] Bulletin No. 283. (Washington, 1915.)

can has not been the slowest to move. It may be that our people are too busy making the things required for munitions to be able to give the matter adequate attention, but we could wish to see the same signs of intelligent and organised effort on the part of the general body of chemical manufacturers in this country as we are now witnessing on the other side of the Atlantic. There can be no doubt whatever that with the fierce industrial struggle that will certainly follow the cessation of hostilities, a very serious time, fraught with the greatest peril, is in store for us, and in particular for our chemical industries. With powerful rivals on either side of us, nothing but the application of the same means, the same enlightened skill and intelligence that in the past have brought pre-eminence to Germany, and are now rapidly bringing it to America, can possibly save these industries from ultimate extinction.

It is not our purpose to follow Mr. Waggaman in his account of the methods of manufacture of sulphuric acid except in so far as they throw light on their comparative advantages in special circumstances, or deal with questions peculiar to America. As regards the contact process, his remarks as to its excellences and its commercial limitations are judicious and to the point. It is admittedly a process which demands skilled and intelligent supervision, and in which there is no room for the rule of thumb type of procedure which characterises much of the foreman management in this country. Doubtless the last word has not yet been said on "catalysers" and "poisons," and there is still room for the ingenuity of chemical engineers in the improvement of plant. But, as matters stand at present, for certain grades of oil of vitriol, and especially for those used generally in the manufacture of fertilisers—one of the most important of the outlets of production—chamber acid will probably hold its own for many years to come, especially in view of the important improvements and simplifications in plant and procedure which have been introduced within recent years.

Of the various methods which have been proposed from time to time for accelerating the chamber reactions, those which seem to have found most favour in the States are Pratt's, Meyer's, and Falding's.

In Pratt's process (U.S. patents Nos. 546, 596, 652, 687), which appears to be much used in the southern States, the gases are drawn through the first chamber by a fan, then through a tower packed with quartz, down which flows dilute sulphuric acid, when they are again introduced, by the same fan, into the first chamber. In a number of plants in which this circulatory system is employed less than nine cubic feet of chamber space are required per pound of sulphur burned in twenty-four hours.

In Meyer's arrangement, of which three installations are in use in the States, "tangential" chambers, designed so as simultaneously to mix and cool the reacting gases, are employed. These chambers are cylindrical in form; round the first run lead pipes conveying cold water. The gases are admitted at a tangent near the upper part of the chamber walls, and are discharged from outlets in the centre of the base, thereby acquiring a spiral motion which tends to mix them thoroughly.

In the Falding system the chambers are approximately one and a half times higher than their horizontal dimensions. The gases after passing through the Glover tower are introduced into the chamber near the top, where, being hot, partly from the fact that they have only recently issued from the burners, and partly because their temperature has been raised by the reactions between certain of their constituents, they collect in the upper part of the chamber and form an active layer, which gradually cools and settles down to the bottom of the chamber, where the spent gases are drawn off. It is claimed that this system requires much less chamber space in which to complete the reactions than the ordinary type. Each Falding chamber is a unit in itself, and is connected directly with the Glover tower, instead of in series as in ordinary chamber systems. Whatever doubts may exist as to the proper explanation of the mechanism of the process, it seems to be commercially successful, to judge from the number of plants in which it is in operation.

The new modification of the chamber process to which Mr. Waggaman refers consists of a method of more quickly effecting an admixture of the reacting gases by causing them to traverse a spiral tube of lead, kept at a determinate temperature. The arrangement has only been tried on a laboratory scale, but from the published results it promises well. Whether it will diminish the chamber space to the extent of 0·139 cubic foot for every pound of sulphur burned in twenty-four hours, as is claimed, seems too good to be true. Comparative experiments using glass and lead spirals appeared to indicate that the metal exerted a specific (catalytic) action. The construction of a sulphuric acid plant along the lines indicated by the author, if successful in working, would certainly greatly diminish the amount of ground space needed, and would presumably decrease the initial cost of construction. The practical man is apt to deride laboratory experiments, forgetting that all factory experience has its beginning in small scale trials. Perhaps he may think it significant that "if patent is allowed, it will be donated to the people of the United States."

NOTES.

EARLY in 1914 a committee representative of British geologists and friends of Sir Archibald Geikie was formed with the object of presenting to the Museum of Practical Geology a suitable memorial of his long association with that institution as director-general of the Geological Survey and Museum, and as a record of their appreciation of his brilliant labours in the cause of geology. It was decided that the memorial should take the form of a marble bust. On Tuesday, March 14, a number of Sir Archibald Geikie's friends

assembled in the museum to witness the presentation. Dr. A. Strahan, director of the Geological Survey and Museum, briefly recapitulated the history of the movement. The Right Hon. Sir William Mather, who was to have unveiled the bust, was unfortunately prevented from attending by a chill, but his place was kindly taken, at the last moment, by Sir William Garforth, who had played a very active part on the committee. After unveiling the bust, Sir William referred in cordial terms to Sir Archibald's contributions to science and literature, and then, on behalf of the subscribers, presented the bust to the museum. The Right Hon. J. Herbert Lewis accepted the gift on behalf of the Board of Education; he remarked that it was a source of gratification to the Board that the artist commissioned to execute the bust happened to be another of its distinguished servants, Prof. E. Lanteri, who had done so much to uphold the standards of the Royal College of Art. The Right Hon. Lord Rayleigh then, on behalf of the subscribers, presented to Sir A. Geikie a marble replica of the bust. In warmly acknowledging his appreciation of the gift, Sir Archibald spoke of the powerful effect the Museum of Practical Geology had had upon him in his early student days, and of the great educational value of its collections. The bust is a remarkably good likeness and a beautiful example of Lanteri's work. Among those present at the ceremony were Sir T. Lauder Brunton, Sir Lazarus Fletcher, Sir Thomas H. Holland, Sir F. G. Kenyon, the Right Hon. Lord Lyell, Major F. G. Ogilvie, Prof. W. W. Watts, Dr. A. Smith Woodward, and Messrs. Bedford McNeill and C. McDermid, representing the Institution of Mining and Metallurgy.

Members of the British Association who attended the Dundee meeting in 1912 will remember the striking announcement made on the first night, that Sir James Caird (then Dr. Caird), one of the leading business men of the city, had given the sum of 10,000*l.* towards the funds of the association. We regret now to announce that this eminent citizen of Dundee, and great public benefactor, died on March 9, at seventy-nine years of age. During his lifetime his donations for public purposes amounted to a quarter of a million pounds, among them being, in addition to the gift to the British Association, 5000*l.* to the Royal Society, 24,000*l.* for Shackleton's Antarctic Expedition, 1000*l.* to the Zoological Society of London, and gifts of valuable collections to the Dundee Museum. In 1903 the University of St. Andrews, "in consideration of his great and practical interest in the philanthropic and educational work of the city," conferred on him the degree of Doctor of Laws, and he received the distinction of a baronetcy in 1913.

The death of Lady Baker, widow of Sir Samuel Baker, closes one of the most romantic careers in the history of the Upper Nile and Uganda. She was Hungarian by birth, being a daughter of Finian von Sass. She nursed Samuel Baker through a serious illness, and her devotion then led to a marriage of exceptional harmony and usefulness. It was doubtless largely owing to her influence that Baker developed from a sportsman into a geographer and ultimately into a statesman. He went to the Upper Nile to shoot big game; he gradually devoted more and more of his attention to geographical exploration, and finally, as he and his wife realised the deplorable condition of the natives, Baker entered on the crusade for the suppression of the slave trade, which led to the Egyptian conquest of the Sudan and the African work of Gordon. In the widening of Baker's sympathies and his adoption of a philanthropic, political mission, he was obviously inspired by his wife. She accompanied him on his expedition in 1860–62 into Abyssinia, and on the important expedition of 1862–65 which discovered the Albert Nyanza, and she returned with him to the Upper Nile in 1870, and on the expedition which established Egyptian supremacy there, and began the long campaign against the Sudan slave trade, which was pursued with varying fortune until the collapse of Mahdism and the Anglo-British reconquest. Lady Baker proved throughout of heroic courage, gifted with remarkable insight into the native mind, and exceptionally fertile in resource. On more than one occasion her quick realisation of danger and prompt action saved the expedition from disaster. In 1874 Sir Samuel Baker purchased an estate near Newton Abbot, South Devon, where he died in 1893, and where Lady Baker lived until her death on Saturday last, March 11.

Sir John Wolfe Barry has been elected an honorary member of the Institution of Civil Engineers.

Dr. Th. Hesselberg informs us that since the beginning of this year he has taken up his functions as director of l'Institut météorologique de Norvège, Kristiania.

The Institute of Industry, Ltd., has arranged a conference of representative trade interests to be held at the Savoy Hotel on Thursday, March 30, to discuss "The Creation of a National Organisation adequately representing British Industrial Interests."

At the meeting of the Royal Society of Edinburgh, held on March 6, the following candidates were elected Fellows of the Society:—Dr. R. J. T. Bell, Dr. F. E. Bradley, Mr. H. Briggs, Mr. C. T. Clough, Dr. E. J. Crombie, Mr. E. H. Cunningham Craig, Dr. A. W. Gibb, the Hon. Lord Guthrie, Prof. P. T. Herring, Sir Duncan A. Johnston, Mr. H. Levy, Dr. J. E. Mackenzie, Dr. W. F. P. M'Lintock, Prof. R. Muir, Dr. J. Ritchie, Mr. D. Ronald, the Hon. Lord E. T. Salvesen, Mr. D. R. Steuart, Mr. J. Martin White.

Many in England will receive with great regret the news which has reached us that Prof. Oswald Külpe died in Munich on December 30, 1915, at the age of fifty-three. He was well known to students in this country for his original work in psychology and philosophy. He was associated with Prof. Wundt in the foundation of the experimental laboratories at Wurzburg, Bonn, and Munich. One of his recent works, "Die Philosophie der Gegenwart," has been translated into English and published under the title, "Present Philosophy in Germany." He visited this country in May, 1914, on the invitation of the University of London, and delivered a course of lectures on æsthetics at Bedford College.

THE retirement of Dr. Theodore Thomson, C.M.G., from the post of assistant medical officer of the Local Government Board about three years ago, and his recent death at the age of fifty-nine, deprived that Board of an extremely able public servant. Prior to his appointment as a medical inspector of the Board, Dr. Thomson had held the post in succession of medical officer of health of Sheffield and Aberdeen, and in these positions had shown the high quality of work which characterised his later work in a Government Department. His name will always be associated with important reports on two of the largest epidemics of enteric fever, due to water-borne infection, which have occurred in this country, at Maidstone and Worthing respectively. These reports are a model of precise statements of results, as well as of methods of investigation. In the important international work of the Local Government Board, Dr. Thomson for many years took a chief part, and he was the British delegate in 1903 to the International Sanitary Conference of Paris, and signed the International Sanitary Convention as the Plenipotentiary of the British Government. For this work and his special mission of inquiry into the sanitary defence of the Persian Gulf he was nominated a C.M.G. in 1905.

IN a lecture recently delivered before the Hyderabad (Deccan) Archæological Society, Sir John Marshall, Director-General of Archæology in India, directed attention to the importance of the Deccan as a field for inquiry. The points on which investigations in this region may be expected to throw light are: the date of the interments usually supposed to be prehistoric, but probably of a later age; whether the copper culture of northern India extended south of the Vindhyan range, and whence the use of iron was introduced. Recently a rock inscription of Asoka has been discovered at Maski, unique inasmuch as it refers to the Emperor under his own name, these edicts of Asoka being the earliest records we possess in India, except one bearing an Aramaic inscription recently found at Taxila. He went on to refer to the number of cave temples and monasteries, the paintings in the Ajanta and Ellora caves, and the splendid series of Saracenic buildings scattered over the region. The new society has a great work before it, and under the skilful supervision of Sir John Marshall important results bearing on the ethnography and history of southern India may be confidently expected.

IN an article in the *Daily Telegraph* of February 29 Sir Robert Hadfield points out that most of the discoveries which have proved of industrial importance have not emanated from Germany. It must be remembered, however, that the country in which the discovery is made does not of necessity reap the benefit which accrues from its commercial exploitation. When, as in Sir Robert Hadfield's own case, the discoverer can foresee the industrial possibilities, and is able to put his ideas into practice, success is bound to follow. He quotes Mr. C. R. Darling as showing that none of the prominent advances in connection with pyrometry have originated in Germany; but here again the important industry which has arisen in this country in the manufacture of pyrometers is due to the skilled scientific men who have seen how to apply new principles to the production of useful instruments. All the evidence shows that our future commercial success depends upon a closer alliance between science and industry. No scheme to achieve this end can be complete which does not foster the prosecution of laboratory research, and thus provide the seeds from which industries grow. Encouragement and financial aid should be given to all who devote themselves to research; and to this end funds should be forthcoming, either from private sources or the Government, or from both. In this way the laboratory can be connected with the workshop, to the great advantage of both.

THE *Pioneer Mail* of February 5 contains an interesting account of the presidential address delivered by Dr. H. H. Hayden to the Mining and Geological Institute of India, which dealt particularly with problems raised by the war. As director of the Geological Survey of India, Dr. Hayden spoke with the authority of an expert, and his description of the German metal ring and its vast ramifications was peculiarly instructive. He explained that for years past Germany had been gradually acquiring control, not only of metals, but also of the raw materials for their production. Her activities embraced Europe, America, Australia, and India. In Australia, for example, the Zinc Corporation had contracted to sell to her all their concentrates until the year 1919; Germany took the entire wolfram output of Burma, and the monazite sands of Travancore were being worked by German firms, the production of thorium nitrate being so regulated that the gas-mantle industry was completely controlled. Dr. Hayden then turned to India's opportunities of developing her own resources. The wolfram output of Burma is being expanded; the tungsten industry has been taken out of German hands, and a new British industry has been established. Dr. Hayden suggests that it would pay to make ferro-tungsten on the spot if the electrical method could be economically introduced into Tavoz. Dr. Fermor has shown that the manufacture of ferro-manganese may be regarded as a sound commercial proposition. If, then, India can arrange for the partially finished product to be exported instead of the ores, the tungsten and manganese industries should be assured of that permanence which is so desirable. Dr. Hayden also touched on the question of the manufacture of coal-tar dyes and the glass industry, especially in the matter of the supply of glass bangles, which latter he regards very hopefully.

WE are pleased to note from an inaugural address published in our American contemporary, *Science*, that there has been formed recently in the city of Rochester, N.Y., an "Association for the Advancement of Applied Optics." The event is one which marks the growing estimation by scientific men, and we hope also by the community at large, on the other side of the Atlantic of the importance of the subject of applied optics. During the past few months we have several times directed attention in these columns to the governmental, scientific, and popular neglect of this very important subject, and to some of the consequences of its neglect in our own country in

connection with the war. It has been shown how we, the successors of Newton, Young, Herschel, and other leaders in the early development of the science of optics and its applications, have allowed our German rivals to occupy the ground during the last twenty or thirty years. Not that we have been idle during that time, but that our efforts have not been commensurate with the ever-growing importance of the subject. For instance, we have anticipated our American cousins in this very matter, for we have had since 1902 a scientific society, "The Optical Society," the work of which completely covers the ground planned out for the new association in America. Its new president, Mr. W. J. Cheshire, a well-known worker in optics, has just succeeded the retiring president, Dr. W. Ettles, a well-known ophthalmologist, and its list of past presidents includes the familiar names of Dr. Silvanus P. Thompson and Dr. R. T. Glazebrook. What is wanted here is a keener appreciation by the scientific and general public of the importance of the work to be done. We venture to hope that the action of our American colleagues will stimulate interest here, and we wish the new association a successful career, especially as from the inaugural address in our contemporary we find that its founders are fully alive to the far-reaching ramifications of applied optics.

WITH the death in France of Mr. Frank Southgate a unique personality in the world of bird-men has passed away. As a landscape painter of the coast of Norfolk and the broads (the delicate atmospheric effects of which he could catch in a magic way), he is of course most widely known. Here we are only concerned with his life studies of birds, although his ability to paint the scenes in which these birds live adds greatly to the beauty of his pictures. A sportsman and a naturalist, no one knew better than he did the appearance, the movements, and the attitudes of those marsh-, shore-, and sea-birds which he delighted to study. But no one else has ever been able to reproduce them in pictures so successfully. Perfectly able, as he was, to draw and paint a detailed portrait of a bird, he aimed rather at showing us exactly what the birds looked like at a little distance in their natural haunts. Who among those who are familiar with the east-country books which he illustrated has not delighted in "The Fringe of the Shore," the "Stricken Mallard," and "A Corner in Broadland," for instance, to be found in "Notes of an East-coast Naturalist." But it was perhaps in depicting birds in flight that his gift of painting live birds was most remarkable. "Smack putting up Common and Velvet Scoters," in the last-named book, is a good instance of his powers. No subject of this kind was too daring for him to attempt, or too difficult to surmount. But we think that when he painted the heron dropping down to alight "In the old fen" ("Wild Life in East Anglia"), he probably reached the climax in this kind of illustration. As we look at the picture once more we marvel again at any artist daring to make the attempt—and at his success.

THE Paris Academy of Sciences awards each year a certain number of prizes to authors of important contributions to science. At the recent annual meeting of the academy, the president, M. Gaston Darboux, gave an account of the careers of men, for the most part young, to whom these prizes had been awarded, but who have fallen in the service of their country. M. Marty (Francœur prize), killed September 10, 1914, at the battle of the Meuse, was distinguished by his contributions to mathematics. M. R. Marcelin (Hughes prize), killed near Verdun, in September, 1914. His work on kinetic physical chemistry was remarkable, both in theoretical treatment and on the experimental side. M. Marcel Moulin (Gaston Planté prize), killed at the battle of the Marne, September 6, 1914, founded the Institute of Chronometry at Besançon. M. Viguier (Cahours prize), killed at Beauséjour, March 5, 1915, made his mark in the field of organic chemistry. M. Albert de Romeu (Delesse prize), killed January 12, 1915, at Bucy-le-Long, near the Aisne, was the author of noteworthy petrographic work. M. René Tronquoy (Joseph Labbé prize), wounded and missing, February 20, 1915, was proposed for the Cross of the Légion d'honneur, and was well known for his mineralogical work. M. Blondel (Saintour prize), wounded and missing, September 8, 1914, at Fère-Champenoise, was distinguished for his work on the theory of tides. M. Georges Lery (Gustave Roux prize), killed at the battle of the Marne, September 10, 1914, was a geometer of great promise. Lieut.-Col. Arnaud (Henri Becquerel prize), aged sixty years, died of illness contracted on active service. M. Jean Merlin (Becquerel prize), on the staff of Lyons Observatory, killed at Arrozel, August 29, 1914. He was known by his researches dealing with the theory of numbers. M. Rabioulle (Becquerel prize), on the staff of the Algiers Observatory, killed in the battle of the Aisne, September 21, 1914. M. Jean Chatinay (Fanny Emden prize), killed at Vermelles, October 15, 1914. Commandant Henri Batailler (Wilde prize), killed June 9, 1915, well known for his researches in ballistics.

IT is announced in the *Morning Post* that Mr. Knud Rasmussen, the Danish Arctic explorer, is planning a new expedition to northern Greenland. Mr. Rasmussen's previous work in Greenland is well known. In 1902 he took part in the Danish Literary Expedition with Mylius Ericksen, and in 1908–9 he explored from Cape York to Ellesmere Land. His work has been mainly ethnographical, a task for which Mr. Rasmussen is well suited, as he spent all his boyhood in Greenland, and speaks the Eskimo tongue with fluency. In his "People of the Polar North" he made an exhaustive study of the polar Eskimo from Cape York to Cape Alexander, and probably in this new expedition he means to continue his ethnographical studies. It is proposed that the expedition should start this spring to explore the unknown region between Peary Land and Greenland, or, if ice prevents this, the expedition will first work around Melville Bay. In 1892 Peary, reaching the east coast across the inland ice of Greenland, discovered Independence

Strait, as he thought, cutting off the northern part from the rest of Greenland. That northern part, previously, in 1882, visited by Lockwood, of Greely's expedition, was termed Peary Land, but the late Mylius Ericksen, on that expedition when he lost his life, discovered that the Independence Strait of Peary is really a bay, and that Peary Land is joined to Greenland. The exploration of that region in relation to former migration of Eskimo to the east of Greenland promises important results.

A SUMMARY of the weather for the winter season is issued by the Meteorological Office with its *Weekly Weather Report,* based on the results for the thirteen weeks from November 28, 1915, to February 26, 1916. The winter was wet in all parts of the United Kingdom, the greatest excess of rain occurring in the south-east of England, where the fall was 187 per cent. of the average. In the east of England the rainfall was 169 per cent. of the average, and in the Channel Isles it was 160 per cent. The smallest difference from the normal was 118 per cent. of the average in the west of Scotland, and 119 per cent. in the south of Ireland. The rainfall for the winter was greater in the north and east of Scotland than in the winter of 1914–15, elsewhere the rains were less, and in the south-east of England the rainfall was 4·32 in. less. The frequency of rain was everywhere greater than the average, the greatest excess in the number of rain-days being 18 in the south of Ireland and 16 in the south-east and south-west of England. Temperature for the period was in excess of the average over the entire kingdom, the greatest excess occurring in the east and south-east of England and in the midland counties, the difference from the mean ranging from 3° to 4° F. in these districts. The duration of bright sunshine was nowhere very different from the normal, districts with an excess and defect being about equally balanced.

IN the March number of *Man* Mr. Miller Christy describes a strange stone object found in an interment of the Bronze age in the parish of Newport, Essex. It is fashioned from a block of rather coarse, reddish sandstone, erratic boulders of which abound in the neighbourhood. It is roughly cylindrical in shape, with flat ends, but it was not intended to be stood on end. The most remarkable feature is that its sides are traversed longitudinally by five shallow, narrow, round-bottomed, equidistant grooves, which divide in transverse section into five approximately equal rounded lobes. At present the object of this curious specimen is a puzzle. It was not a pounder or muller. One authority suggests that it was the head of a club lashed to a handle; another, that it was used as a roller for "braying" flax. Mr. Reginald Smith was struck by its resemblance to an Egyptian pillar, derived from the bud of the lotus. If it is really a product of the Bronze age, it is difficult to account for its transfer from Egypt to Essex. The specimen is now in the museum at Saffron Walden, and it may be hoped that Mr. Christy's article will lead to a further examination of this remarkable specimen, which may disclose the object for which it was carved.

FROM the report of Mr. T. Southwell in the Journal of Agriculture of Bihar and Orissa for 1915, which has just reached us, it is plain that the newly-formed Fishery Department of Bengal, Bihar, and Orissa has a strenuous future before it, if a reign of plenty is to replace the present shortage of fish. This state of affairs is due to the lack of intelligent control, and is all the more serious since rice and fish are the principal food-stuffs of the population of these areas. But the Government is taking up the task of reformation with its hands tied, for the fishery rights belong to zamindars, who take no interest in the matter, but lease their fisheries for a nominal sum, the lessee re-leases at a large profit, and this process goes on through yet further stages. Apart from this, in the Bengal area immense numbers of eggs and young fish are washed by the floods into the paddy-fields and destroyed, while a further extensive mortality is caused by the ascent of brackish water. But Mr. Southwell seems to hold out little hope of material improvement until the staff of the newly-established Board is increased. At present there are but three officers to control an area "one and a half times larger than that of the whole of the British Isles."

THE hereditary transmission of degeneracy and deformities by the descendants of alcoholised guinea-pigs has formed the subject of a long series of experiments by Profs. C. Stockard and G. Papinicolaou. They contribute a very welcome analysis of their results so far obtained to the *American Naturalist* for February. Their experiments show that alcoholic fumes, drawn directly into the lungs and absorbed by the blood, are infinitely more harmful to the offspring than is alcohol taken into the system in the form of drink. Alcoholic fumes made the animals drowsy, or quarrelsome, according to their individual temperament, but they produced no other evil effects during the lifetime of the animal, nor could any injury to the tissues be traced after death. This is notoriously otherwise where men who have been "hard drinkers" are concerned. Guinea-pigs kept in an almost continuous state of intoxication during the reproductive period invariably produce defective offspring, of which very few arrive at maturity. In spite of the fact that alcohol is withheld from them, the offspring of such defectives are still more defective. All are weak and neurotic, some are grossly deformed, many are anophthalmic monsters. Physical wrecks of this sort continued to appear for three generations, when sterility seems to have extinguished further examples. Attempts to administer alcohol in the form of drink, by means of a tube, or mixed with the food, had to be abandoned owing to digestive and other troubles which vitiated the experiments. But before the authors can claim to have demonstrated the destructive effects of alcohol fumes on the germ-plasm, experiments with non-alcoholic fumes must be tried.

A SELECTED bibliography of frost in the United States, especially in relation to agriculture, has been published as a pamphlet by the United States Department of Agriculture. It originally appeared in the pages of the *Monthly Weather Review* (vol. xliii., pp. 512–517). The authors, Messrs. W. G. Reed and

C. L. Feldkamp, have selected their entries from all the material on frost and frost prevention under American conditions that have come to their attention, but disclaim any exhaustiveness for their list. A brief indication of the scope follows each entry. The arrangement is chronological and there is an index arranged according to States. The paper should prove useful to agriculturists.

THE *Geographical Review* is the new title under which the Bulletin of the American Geographical Society appears this year. An introductory note outlines the scheme of the remodelled publication. It is hoped to broaden the range of the articles and to give the notes and reviews a more critical and scholarly quality. A special feature is to be made of the bibliographical section, which, in addition to the record of books and maps, will contain an analysis of all the principal geographical publications and those bearing on geography. The classification adopted is a regional one, and is illustrated in a sketch map in the January issue. If the high standard aimed at is maintained the *Geographical Review* should rank among the most useful geographical publications and be of great assistance in the study of the subject. The January number (vol. i., No. 1), in addition to several shorter articles, notes, and bibliography, contains a lengthy paper by Mr. C. A. Cotton on fault coasts, with special reference to New Zealand.

AN investigation of the world's coal resources was undertaken by the twelfth International Geological Congress, held in Canada in the summer of 1912, with the view of estimating the tonnage available in known fields. In October last the American Geographical Society published in its Bulletin (vol. xlvii., No. 10) a summary of the results, which have been embodied *in extenso* in a monograph of three volumes published by Morang and Co., Toronto, 1913. The author of this summary, Mr. Leon Dominian, finds that on the basis of the present annual consumption of 1300 million tons, the world's coal supply is provided for centuries.

BULLETIN 254 of the Scientific Papers of the Bureau of Standards (Washington: Government Printing Office, 1915) contains a study of the qualities of platinum goods, by Messrs. George K. Burgess and P. D. Sale. The object of the investigations was in the first place to devise a simple thermoelectric test of the purity of platinum, for which purpose the temperature-coefficient of resistance and the thermoelectric force were found useful; in the second place, to investigate the loss of weight due to disintegration when platinum vessels containing various proportions of other metallic constituents are heated.

IN a series of articles in the February numbers of the *Electrician*, Mr. W. R. Cooper has given an account of the properties of selenium which will prove of great value to all those who have in view the technical applications of the sensitiveness to light which the material exhibits. Up to the appearance of these articles it has been necessary to collect information on the subject from the pages of scientific journals published in all parts of the world. Mr. Cooper's articles now provide the information in a convenient and readable form. After an account of the various forms of selenium and the modes of preparation, their sensitiveness to light in general and to variations of the wave-length of the light are discussed. Although a satisfactory general theory has not yet been evolved from the experimental facts now available, there is sufficient information about the behaviour of the material to make it likely that its properties will before long find for it some more extensive application than at present, when it is mainly restricted to the automatic lighting of isolated buoys at sea.

WE congratulate the *Athenaeum* on the promptitude with which it has been able to publish its subject-index to the Periodical, Scientific, and Technological Literature for 1915. The publication of this list within six weeks of the close of the year indexed is a remarkable feat. The list is by no means intended to be a complete index to all branches of scientific literature, but has special reference to the war in its technological aspects. Indeed, a complete list of the scientific papers published throughout the world in 1915 would probably contain 40,000 names of authors, whereas in the *Athenaeum* list we have rather fewer than 2000 names quoted. The subject-index is arranged alphabetically. The following examples of the headings for some of the longer sections will give an idea of the character of the subjects selected for indexing:—"Aeronautics," "Agriculture," "Artillery," "Automobiles," "Birds," "Coal," "Electric Apparatus," "Explosives," "Forestry," "Gas and Oil Engines," "Geology," "Mines," "Railways," "Roads," "Submarines," "Telegraphs," "Telephones," "Warships," and "X-Rays." The articles indexed are taken from 215 periodicals, which are mainly British, although thirty American and seven French periodicals are included, as well as about ten other foreign journals.

Engineering for March 10 contains the last of a series of articles on the whirling speeds of loaded shafts; these articles describe an investigation which has been made at the Royal Technical College, Glasgow, by Mr. W. Kerr. Tests on a 250-kw. turbine, and on a 3-h.p. de Laval turbine, showed some disagreement with the usual theory, and led the author to investigate the matter mathematically. It appears that there is both experimental and theoretical evidence of the existence of a critical speed for loaded horizontal shafts which is considerably below that given by the usual theory. This new critical speed is due in the first instance to the direct effect of gravity, which has been hitherto neglected in the theory. The lower critical speed seems to be less important than the higher, when it is merely a question of running through in the process of speeding up. Also, it is of little importance if the loads on the shaft are very light. In those cases in which it is shown clearly, it is probably due to inaccurate balancing. In general, there will be an undesirable instability at all speeds between the two critical values, and it would be best to keep the normal running speed outside this range.

MESSRS. JOHN WHELDON AND CO., 38 Great Queen Street, Kingsway, W.C., have just issued a catalogue of important books and papers on cryptogamic botany they are offering for sale. The works are arranged conveniently under three main divisions—economic, geographical, and general—each of which is subdivided to facilitate search for works on any particular subjects embraced by the catalogue.

OUR ASTRONOMICAL COLUMN.

COMET 1916*a* (NEUJMIN).—Copenhagen Postcards Nos. 13 and 14 give orbits and ephemerides for this comet calculated by M. J. Fischer-Petersen and Mlle. J. M. Vinter-Hansen. The earlier orbit is based on observations made at Yerkes (February 29), Greenwich (March 1), and at Bamberg on March 3. The second, given below, depends on the Yerkes and Bamberg positions, and observations made at Bergedorf on March 5:—

Perihelion Passage (T), 1916, *March*, 9·417 *G.M.T.*

$$\left.\begin{array}{l}\omega = 191^\circ\ 9'\ 87'' \\ \Omega = 325^\circ\ 24'\ 10'' \\ i = 16^\circ\ 1'\ 48''\end{array}\right\}1916{\cdot}0$$

$$\log q = 0{\cdot}19036$$

	R.A. h. m. s.	Dec. ° ′		R.A. h. m. s.	Dec. ° ′
March 15	9 5 41	+5 58·2	March 21	9 10 56	+3 11·1
17	7 17	5 1·2	23	12 57	2 18·1
19	9 2	4 5·4	25	15 6	1 26·7

The orbit is apparently periodic in short period. The comet is fainter than 11·0 mag.

COMET 1915*e* (TAYLOR).—A new orbit and ephemeris for this comet has been calculated by M. J. Braae from observations made at Rome, December 5, 1915, at Arcetri and Copenhagen, January 11, 1916, and at Bamberg and Copenhagen on February 20. The new orbit only differs slightly from the earlier elliptical orbit (NATURE, January 20):—

Perihelion Passage (*T*) = 1916, January 30·9122 *G.M.T.*

Epoch 1916 Jan. 0·5 G.M.T.	Equinox 1916·0
$M_0 = 355^\circ\ 17'\ 34{\cdot}6''$	$\omega = 354^\circ\ 47'\ 54{\cdot}9''$
$\mu = 557''{\cdot}191$	$\Omega = 113\ 53\ 57{\cdot}6$
$\text{Log } a = 0{\cdot}536002$	$i = 15\ 31\ 51{\cdot}0$
$U = 2325{\cdot}95$ days (6·37 years).	$\phi = 33\ 7\ 33{\cdot}9$

The comet is very weak, having been about 12 mag. on February 20.

From Bergedorf, Prof. Schorr has reported (Circular No. 503, *Astronomische Nachrichten*) that the nucleus of this comet has divided into two portions. The nuclei were of unequal brightness, about magnitudes 11 and 13. Their positions were:—Distance, 14″; position angle, 169° and 17″ and 25°, on February 19 and 29 respectively. On the latter date the following nucleus was the weaker.

According to a note in the current number of the *Observatory*, Prof. E. E. Barnard observed the double nucleus on February 9, the separation being 10″.

VARIABLE STARS IN THE VICINITY OF R CORONÆ AUSTRALIS.—This region is under careful scrutiny, not only at Helwân, but also at the Union Observatory, Johannesburg. In Circular No. 31 both R Coronæ and the nebula are stated to be variable over a wide range. The observations of these objects are to be discussed later. Thirty-three new variable stars have been detected in the region.

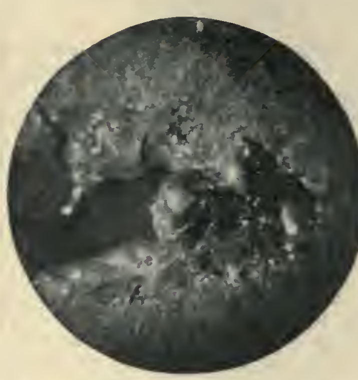
A POSSIBLE DEFLECTION OF LIGHT BY A MOVING MEDIUM.—Prof. P. Zeeman has published (*K. Akademie van Wetenschapen*, vol. xviii., pp. 711–5) an investigation of the propagation of light-waves along a velocity gradient in a moving medium specially in relation to solar phenomena. From a consideration of the Lorentz dispersion term in the Fresnel coefficient, it is demonstrated that the simultaneous existence of velocity gradients and anomalous dispersion in gases that are extremely rare (*e.g.* the absorbing vapours giving rise to the finest lines in the solar spectrum), and without density gradients, may give rise to a deflection of light.

A TUNGSTEN TARGET FOR X-RAY TUBES.[1]

GREAT advances have recently been made in the production of X-rays, chiefly by the employment of very heavy currents. The exposures necessary for producing radiographs of the thorax have been reduced from minutes to fractions of a second.

To make this possible, much attention has been devoted to the target or anti-kathode, which is the critical part of the tube, for here it is that the focus of the kathode stream strikes, and the energy of the bombarding electrons is transformed into X-radiation.

The early English tubes were furnished with substantial targets of platinum, but in the later foreign tubes with which the market was flooded the platinum was often reduced to a sheet of very thin foil laid upon a plate of nickel. For weak currents, and with an imperfectly focused kathode stream, this plan answered moderately well, but if heavy currents were used the heat generated at the focus was often so great that the platinum skin alloyed with the nickel backing, when fusion and destruction of the whole apparatus followed immediately.



Platinised nickel target damaged by the kathode focus.

This is well illustrated by the accompanying photograph of such a fused target which appeared some time ago in the Journal of the Röntgen Society.

Recently attention has been directed to the exceptional properties of pure metallic tungsten, now produced in quantity for the manufacture of metal filament lamps, and its suitability for the purpose was at once recognised, the metal having a fusing point of about 3000° C., as against 1750° C. for platinum. Tungsten is also very tough, and does not readily disintegrate by the kathodic discharge (kathode sputtering); its atomic weight, 180, is not much below that of platinum.

The British Thomson-Houston Company, Ltd., has introduced a special target of this metal that is being largely used by manufacturers of X-ray tubes. The tungsten is in the form of a thick button brazed into a solid block of copper, in some cases weighing as much as half a pound; this forms a lasting and efficient target, even when heavy currents are used

1 "Quantitative Measurements of the Conversion of Kathode Rays into Röntgen Rays by Anti-kathodes of different Metals." By J. H. Gardiner. Journal of the Röntgen Society, No. 24, vol. vi.

for considerable periods of time, as is often necessary when using X-rays for therapeutic purposes.

The adaptation of tungsten for this purpose is an example of the great value that lies hidden in the rare and little-known elements, and doubtless other instances of a similar nature will develop as the metals become available.

OSMOTIC PRESSURE OR OSMOTIC SUCTION?

IT has often been assumed that van't Hoff's discovery, that the simple gas-law, PV=RT, may be applied to the osmotic pressures of dilute solutions, justifies the view that osmotic pressure is caused by the bombardment of a semi-permeable membrane by the molecules of the solute, just as gas-pressure is caused by the bombardment of the containing vessel by rapidly moving gas-molecules. A recent exposition of this view by Prof. Ehrenfest, in the Proceedings of the Amsterdam Academy (vol. xvii., pp. 1241–1245), has elicited a reply from Prof. J. J. van Laar (*ibid.*, vol. xviii., pp. 184–190), which will be read with very great interest by all those who have seen in the mechanism of osmosis an even more difficult problem than that of expressing the magnitude of the osmotic pressure by means of a mathematical formula. Prof. van Laar's reply is of exceptional value in that it demonstrates the inadequacy of the gas-analogy from the thermodynamic point of view, and so challenges the simple kinetic theory of osmosis on what has generally been supposed to be its strongest ground.

The osmotic pressure may be expressed, according to Van Laar, by the equation,

$$P = RT/v_0\{-\log(1-x) + \alpha x^2\},$$

where x is the molecular concentration of the dissolved substance, and α is an "influencing" coefficient, which expresses the consequences of the interaction of the molecules of the solvent with those of the dissolved substance. The logarithmic term is an essential feature of the thermodynamic equation, and it is urged that all kinetic theories which lead to expressions without a logarithmic member must be rejected.

The thermodynamic equation, it is true, leads to an expression for dilute solutions which is identical with that of van't Hoff. But in practice it is found that in more concentrated solutions deviations appear which are much smaller than those for non-ideal gases. We may therefore surmise that the so-called osmotic pressure has an entirely different ground from that suggested by van't Hoff's application of the gas-equation, and that there is here no close relation but merely an analogy.

If the osmotic pressure were actually caused by the pressure of the dissolved substance, as Ehrenfest, reviving the old theory, suggests, the pressure of the sugar molecules against the semi-permeable membrane would, in van Laar's opinion, cause the reverse effect to that which is actually observed. No water would pass from the pure solvent through the membrane into the solution, giving rise to a hydrostatic pressure in the osmometer; but, on the contrary, the inward flow of water would be checked, since the pressure in the solution would from the outset be greater than in pure water. In reality, osmotic pressure is caused by the water which penetrates through the semi-permeable membrane, giving rise to a hydrostatic pressure which prevents the further intrusion of the water. This excess of pressure is the so-called "osmotic pressure" of the solution.

Generally speaking, every theory which seeks to interpret osmotic pressure kinetically must be based on the *diffusion* of the water molecules on the two sides of the membrane. If this is done, the logarithmic member arises of its own accord, and finds a place in the equation, whether there is interaction between solvent or solute or not, *i.e.* the α-term appears quite independently of the logarithmic term. In van Laar's opinion, the kinetic interpretation of osmotic pressure, which is always reappearing again in new forms, is moving, and has moved, in a wrong direction, and should again be founded on the simple diffusion phenomenon.

T. M. L.

POST-GRADUATE SCHOLARSHIPS AND FELLOWSHIPS.

THE new list of scholarships and fellowships offered by the Leeds University has just been issued. It includes some twelve entrance scholarships in arts, science, medicine, and technology, awarded on the results of the matriculation examination of the Joint Matriculation Board, in addition to a certain number (not specified) given by the local education authority. There are also twelve Clothworkers' free studentships in the textile department, and a "William Cooke" scholarship in mining, determined by special examination or selection. In addition to the above are a number of senior scholarships, awarded to students of special merit in the University, by the University, the Leeds City Council, and by various donors who have wished to perpetuate with their names their interest in the University. Such are the Leighton exhibitions established by the trustees of Mrs. Isabel Leighton, of Leeds, the Salt scholarship given by Sir Titus Salt, the John Rutson scholarship, and the Gilchrist studentship in modern languages. The list of post-graduate scholarships and fellowships is a very meagre one. There is one 1851 exhibition scholarship of 150*l.* tenable for two years, and a number of 1851 exhibition industrial bursaries of 100*l.*, both awarded by the 1851 Exhibition Commissioners, the first in science and the second in some branch of technology. There is, further, a research scholarship in colour chemistry founded by the Clothworkers, and a scholarship in gas engineering endowed by Sir Corbet Woodall. There are also two scholarships in the faculty of medicine. A limited number of research fellowships are also awarded by the University to distinguished graduates; there is one in connection with the fuel department in gas research founded by the Institute of Gas Engineers, and one in colour and textile chemistry.

It is generally recognised by university teachers that the year or years immediately following graduation are in a sense the critical years of a student's career. In science more especially he has laid up a fund of knowledge which he is about to turn to practical account. He has collected a store of potential energy; he has played the *rôle* of an "accumulator" during his university course, and his energy is now to be turned to useful work. In the northern universities at least the graduate has to earn his living, and whilst he is on the look-out for congenial, as well as remunerative, occupation he may often have to wait for many months. It is at this critical time that a post-graduate scholarship, sufficient for the student to keep himself and release his parents from the burden of further maintenance, is invaluable. It is invaluable not merely because it gives him time to look round and relieves him from the necessity of accepting the first vacancy that offers; but because he is learning in that excellent school of research how to use his knowledge and more especially how to depend upon himself.

In the "Scheme for the Organisation and Development of Scientific and Industrial Research" issued by the Board of Education we have the promise of a large extension of post-graduate research studentships and

fellowships. Although there may be cause for criticism of the method of administration of the fund placed in the hands of the committee of the Privy Council, there is no doubt that, if wisely administered, it will have very far-reaching results, not only in developing our scientific industries, but in stimulating research in our universities and levelling up the standard of scientific attainment among the whole body of our science students.

INSTITUTION OF MECHANICAL ENGINEERS.

THE annual report of the council of the Institution of Mechanical Engineers for the year 1915 shows that the fund raised in conjunction with other institutions to establish a memorial to the late Sir W. H. White, K.C.B., amounted to more than 3000*l*. After providing for a medallion portrait, to be placed in the Institution of Civil Engineers, and a donation to the Westminster Hospital, the bulk of the fund, together with any further contributions, is being devoted to the establishment of a research scholarship in naval architecture, to be administered by the Institution of Naval Architects. The report also states that the Thomas Hawksley medal for 1916 has been awarded to Prof. H. L. Callendar, for his paper "On the Steady Flow of Steam through a Nozzle or Throttle," and premiums of 5*l*. each have been awarded to Prof. A. H. Gibson and Mr. W. J. Walker, for their paper on "The Distribution of Heat in the Cylinder of a Gas Engine." A grant of 15*l*. has been made from the Bryan Donkin Fund, for original research in mechanical engineering, to Mr. A. H. Barker, in aid of his research at University College, London, "to investigate a new method of determining the radiant temperature and air temperature in a room." The balance of the third triennial award has been devoted to aiding the steam-nozzles and hardness tests researches of the institution.

The report contains particulars of the work done during the year by the various research committees of the institution. The work of the Alloys Research Committee, on the alloys of aluminium with zinc and copper, has been continued at the National Physical Laboratory. The importance of light alloys in connection with aeronautics has led to a Government grant for the erection and working of an experimental rolling-mill capable of dealing with ingots and billets. Further progress has been made with other branches of the work, including the study of the constitution of the alloys and the "disintegration" research. The series of researches relating to the double carbides of iron, under the direction of Profs. J. O. Arnold and A. A. Read, has been completed. The results of the studies on the carbides of cobalt and of molybdenum have been embodied in papers on "The Chemical and Mechanical Relations of Iron, Cobalt, and Carbon" and "The Chemical and Mechanical Relations of Iron, Molybdenum, and Carbon," both printed in the Proceedings of the Institution. A report was also submitted by Sir Robert Hadfield describing the effects of molybdenum upon iron, up to 18 per cent. of Mo. The Steam-Nozzles Research Committee has held three meetings and is engaged on the design of apparatus for conducting experiments relating to the action of steam passing through nozzles and steam-turbines. The British Westinghouse Electric and Manufacturing Company has offered to lend two large condensers to the committee, and substantial progress has been made with the design of nozzle-testing apparatus. The Hardness Tests Research Committee has been considering the design of a machine to determine rate of wear as a measure of hardness. An existing machine at the National Physical Laboratory was adapted as a preliminary procedure, but the results obtained from this machine and modifications thereof have not yet been satisfactory. The work of the Refrigeration Research Committee has been suspended, Prof. C. Frewen Jenkin, the reporter, being on active service.

Interesting particulars of the war work undertaken by members of the institution are contained in the report. The engineer unit of the Royal Naval Division, which was principally recruited from the members of the Institutions of the Civil, the Mechanical, and the Electrical Engineers, was on active service in Gallipoli. In the early stages of the war, a list was compiled of the engineering and other qualifications of members desiring to obtain commissions in the Army, and copies were forwarded to quarters where they were likely to be of use. The names of selected members have been put forward as candidates for commissions in the 12th King's Own (Yorkshire Light Infantry), Pioneer Companies, the Mechanical Transport branch of the Army Service Corps, and other engineering branches of the Army. Particulars of the engineering training and other qualifications of 159 members who expressed a desire to undertake engineering work in connection with the war have been forwarded to the Ministry of Munitions and other Government departments from time to time throughout the year. In response to an application from the Ministry of Munitions for the nomination of engineers for employment in connection with contracts for the manufacture of munitions, the council appointed a small committee to select possible candidates. The qualifications of sixty-seven members and others were considered, and the names of twenty-seven were submitted to the Ministry. In August last a list of 543 members on active service in the Army was compiled for transmission to the War Office. During the year 661 members had been on active service. Several designs for a mechanical bomb-thrower have been received from members and submitted to the War Office. Designs have also been submitted of apparatus for destroying barbed-wire entanglements, for clearing mines from the products of the explosion of the mine, and for non-slip chains for rubber tyres of motor-wagons. At the request of the Director of Fortifications and Works, a list was compiled of the names of mechanical engineers with whom the War Office might communicate in connection with problems arising out of the war.

THE ORIGIN OF ENGLISH MEASURES OF LENGTH.[1]

ALTHOUGH there is considerable variety in the measures of length used by the different nations of the world, there can be no doubt that they are, for the most part, derived from a common origin, and that their ancestors, if the expression may be used, existed in times so remote that the date of their invention has been completely lost.

For the sake of clearness, it is convenient to divide the measures of length into four categories which are, to a certain extent, independent of one another, and may be defined as follows:—

(1) The shorter measures of length, used for building and manufacturing purposes, of which the more important in ancient times were the cubit, the palm, and the digit, or finger breadth, and the English representatives are the yard, the foot, and the inch.

[1] Abridged from a paper in the Journal of the Royal Society of Arts, December 31, 1915, by Sir Charles M. Watson, K.C.M.G., C.B.

(2) The shorter measures of distance, such as the foot, the yard, and the pace. (3) The longer measures of distance, including the stadium, the mile, the parasang, the schoenos, the league, the hour's march, and the day's march. (4) Measures of length used in connection with the calculation of land areas, of which the English representatives are the perch, the chain, and the furlong.

As regards the first of these classes of measures, it is generally accepted that they were, from the earliest times, based on the proportions of the human body, so that every man had his own scale to which he could work.

The palm is the width across the open hand at the base of the fingers; the cubit is the length of the arm from the elbow to the end of the middle finger; and the fathom the length of the outstretched arms. There is no fixed relationship between these units.

There is no record as to when an attempt was first made to combine the measures in a standard scale, but it was probably at an early period, as it must have been found inconvenient for workers on the same building, for example, to use different lengths of palms and cubits, and, when a standard was fixed, it may have been some such scale as the following:—

	1 digit =	0·7375 English	inch
4 digits =	1 palm =	2·95 „	inches
6 palms =	1 cubit =	17·70 „	„

The cubit of this scale may be called the "cubit of a man," to distinguish it from other cubits, which will be described hereafter.

There is nothing to show when the foot was added to the units of the mechanic's scale, but when this was done it was assumed to be equal to four palms, or two-thirds of a cubit.

The third class of measures of length is the most important, and the history of these is of particular interest, as they appear to have started in a state of perfection, and to have been first used by a people who possessed a high degree of astronomical and mathematical knowledge, who were acquainted with the form of the earth, and were able to carry out geodetical measurements. There can be no doubt that they are based on the angular division of the circle, and on the application of this division to terrestrial measurements.

The unit of angular measurement is the angle of an equilateral triangle, and this angle was divided by the ancient geometricians, for purposes of calculation, into 60°, the best number possible, as $60=3\times4\times5$. Following the same principle, each degree was divided into 60 minutes, and each minute into 60 seconds. As the circle contains six times the angle of an equilateral triangle the circle was divided into 360°. This division of the circle, although so ancient that its origin is unknown, has never been improved upon, and is still in use by all nations. An attempt on the part of certain French mathematicians to substitute a division of the circle into 400°, on account of the supposed advantages of the decimal system, has proved a failure.

The manner in which the division of the circle into 360° was used by the ancients to determine the unit for terrestrial measures of distance was as follows. If a circle be described cutting the equator of the earth at right angles, and passing through the north and south poles, its circumference in angular measurement is equal to $360°\times60'=21.600'$, and the length of 1 minute, measured on the surface of the globe, was taken as the unit, which is called a geographical mile at the present time. If the earth was a perfect sphere, every geographical mile would be of the same length, but, as the polar diameter is less than the equatorial diameter in the proportion of 7900 to 7926, the length of the geographical mile, measured on the meridian, is not the same in all latitudes, but increases in length from 6046 English feet at the equator to 6108 English feet at the poles. Whether the ancient astronomers were acquainted with this irregularity in the figure of the earth it is not possible to say, but it is certain that the value at which they fixed it must have been close to the actual mean value as determined by modern astronomers, which may be taken as about 6075 English feet. The Greek stadion (the same as the Roman stadium), which was one-tenth of the geographical mile, was 600 Greek feet in length, and the Greek foot was about 12·15 of our present English inches.

The next step taken appears to have been with the view of assimilating the subdivisions of the geographical mile with the cubit, and it was not easy to do this, as the cubit of a man has no necessary connection with a geographical mile. The difficulty appears to have been solved by the invention of two new cubits, of which the smaller was very nearly equal to the cubit of a man, and was contained 4000 times in the geographical mile. This, for the sake of distinction, may be called the geographical cubit. The second cubit, afterwards known as the Babylonian Royal cubit, was longer, and was contained 3600 times in the geographical mile. According to Herodotus, this second cubit was three digits longer than the other cubit. On these two cubits there appear to have been based two different divisions of the geographical mile, one in accordance with a decimal, and the other with a sexagesimal system of calculation, but there is, so far as I know, no ancient record of these scales, and the following attempt to compose them is founded on inferences, drawn from the Babylonian, Greek, and Roman measures, all of which, there can be little doubt, came from the same origin.

The first based on the geographical cubit, which was rather longer than the average cubit of a man, is as follows:—

	1 digit	= 0·729	English	inch
25 digits	= 1 geographical cubit	= 18·225	„	inches
100 „	= 1 fathom	= 6·075	„	feet
100 fathoms	= 1 stadion	= 607·5	„	„
10 stadia	= 1 geographical mile	= 6075	„	„

The second, or sexagesimal scale, based on the Babylonian Royal cubit, appears to have been as follows:—

	1 digit	= 0·723	English	inch
28 digits	= 1 Royal cubit	= 20·25	„	inches
60 cubits	= 1 plethron	= 101·25	„	feet
60 plethra	= 1 geographical mile	= 6075	„	„

The ancient Egyptian measures of length, although evidently derived from the same origin as the Babylonian, differ from these in some respects. The most important smaller unit was a cubit usually known as the Egyptian Royal cubit, which was divided into seven palms, each palm of four digits. The approximate length of the Egyptian Royal cubit is well known, as a number of cubit scales have been found which give a mean length of 20·65 English inches, and an examination of the monuments of Egypt shows that this cubit was used for building purposes from ancient times.

It is matter of controversy from whence the Greeks derived their measures of length, whether from Egypt or Babylonia; but the latter appears more probable, as their principal measure of distance, the stadion, was equal to one-tenth of a geographical mile of 6075 English feet, and this was divided into 6 plethra, each of 100 Greek feet. The Greek scale appears to have been as follows:—

	1 Greek foot	= 12·15	English inches
1½ Greek ft.	= 1 cubit	= 18·225	,, ,,
10 ,, ,,	= 1 reed	= 10·125	,, feet
10 reeds	= 1 plethron	= 101·25	,, ,,
6 plethra	= 1 stadion	= 607·50	,, ,,
10 stadia	= 1 geographical mile	= 6075	,, ,,

There was another foot used in Greece, of which Petrie gives a number of instances, derived from old buildings, varying from 11·43 to 11·74, with a mean value of 11·60 English inches. This would appear to be a foot of 16 digits, used for building and manufactures, but not connected with measures of distance.

The Roman system of measures was based on the Greek, but while adopting the stadion—called by them stadium—as the fundamental measure of distance, they used the shorter Greek foot, and introduced another measure, the double pace. They also made the land mile to consist of 8 instead of 10 stadia, while retaining the geographical mile of 10 stadia for use at sea. As they had an affection for a duodecimal system of calculation, they also divided the foot into 12 inches, in addition to the old division into 16 digits. The Roman scale, which showed considerable ingenuity in assimilating a number of different measures which had no real relationship to one another, appears to have been as follows:—

	1 digit	= 0·729	English inch
	1 inch	= 0·972	,, ,,
4 digits or 3 inches	= 1 palm	= 2·916	,, inches
4 palms	= 1 foot	= 11·664	,, ,,
6 ,,	= 1 cubit	= 17·496	,, ,,
5 feet	= 1 pace	= 4·86	,, feet
125 paces	= 1 stadion	= 607·5	,, ,,
8 stadia	= 1 land mile	= 4860	,, ,,
10 ,,	= 1 geographical, or sea mile	= 6075	,, ,,

The above remarks deal with the measures of distance used by the principal nations of antiquity up to and including the geographical mile, upon which they seem to have been based, but in addition to these there are certain longer measures of distance which must be referred to, such as the parasang, the schoenos, and the league. The fundamental idea of these measures was that they represented the distance which could be marched in a given time, such as one hour, and as the rate of marching naturally varied with the nature of the country, it was not easy to have a fixed length, and when there was made a theoretical unit it did not always agree with the actual distance.

An important application of measures of distance from the earliest times was for the calculation of areas of land, but there is considerable doubt as to what was the original unit, and whether this was a square, or in the form of a rectangle one stadium in length and one-tenth of a stadium in width. In the latter case there would have been ten measures in a square stadium, and 1000 measures in a square geographical mile, and such a measure would seem quite in accord with the ancient system of measures of distance. Its area would have been 40×400 geographical cubits (36×360 Babylonian Royal cubits). There is a very widely distributed type of land measures based on a rectangle of this form, of which the English acre is an instance, as it measures 44×440 English cubits.

The Egyptian unit of land area appears to have been the "set," which was a square having a side of 100 Egyptian Royal cubits. A cubit of land was the 1/100 part of this, and was the area of a rectangle 1×100 cubits.

In the Greek system the unit of area was the square of a plethron or 100 Greek feet, of which there were 36 in a square stadion and 3600 in a square geographical mile.

The Roman unit of land area, called the "jugerum," was a rectangle, 120×240 Roman feet, which was subdivided duodecimally, the uncia of land being the twelfth part of a jugerum, or the area of a rectangle measuring 10×240 Roman feet.

It will be seen from the above descriptions that from the earliest times the shorter measures of length were based on the proportions of the human body, and the longer on the geographical mile, and that at some remote period an attempt was made to combine them into a continuous scale, from the digit to the geographical mile.

The modern measures of the civilised world are, with few exceptions, based on the ancient units, of which they may be regarded as the direct descendants. Of these exceptions the most important are the measures of the metric system, which were designed with the object of breaking away from the records of the past by the adoption of a new geographical mile, equal to 54/100 of the true geographical mile.

The English measures of length are a good example of the modern representatives of the old units, and are worthy of study from this point of view. How the measures originally came to England it is not easy to say, but there can be no doubt that they were in use before the Roman invasion, having possibly been introduced by Phœnician traders, and were afterwards modified by the Romans, the Saxons, the Scandinavians, and the Normans, each of whom had measures, based on the old units, but altered in course of time. It was not until the thirteenth century that they were moulded by law into one uniform system.

The English scale, as authorised by statute, may be summarised as follows:—

	1 inch
12 inches	= 1 foot
3 feet	= 1 yard
5½ yards	= 1 rod, pole, or perch
4 perches	= 1 chain
10 chains	= 1 furlong
8 furlongs	= 1 English statute mile

Of these units the inch is derived from the Roman system, being one-twelfth of the foot, but the foot, on the other hand, is equal approximately to the Greek foot, while the yard, which is simply a double cubit, comes from the Babylonian system, being approximately a double geographical cubit. The perch is the English representative of the Babylonian gar, and the furlong occupies a similar place to the stadium, while the mile is composed of eight stadia, apparently in imitation of the division of the Roman mile. For use at sea, however, the geographical mile, divided into ten stadia, or, as we call them, cable lengths, has been retained, as no other mile can be used for purposes of navigation.

In order fully to understand the connection between the English measures and the ancient measures of length, it is necessary to write the scale in a somewhat different manner, and to introduce some other units which are no longer used. The revised scale is as follows:—

	1 barleycorn
3 barleycorns	= 1 inch
3 inches	= 1 palm
4 palms	= 1 foot
6 ,,	= 1 cubit
12 ,,	= 1 double cubit or yard
11 cubits	= 1 perch
405 ,,	= 1 cable's length
4 perches	= 1 acre's breadth or chain
10 chains	= 1 acre's length or furlong
8 furlongs	= 1 English mile
10 cables	= 1 geographical, or sea mile

The English inch is equal in length to 3 barleycorns set end to end. The barleycorn, as a measure, is forgotten, but on a shoemaker's tape the sizes of boots and shoes increase by a barleycorn, or $\frac{1}{3}$ inch, for every size. For example: size No. 8 of a man's boot measures 11 inches; size No. 9, $11\frac{1}{3}$ inches; size No. 10, $11\frac{2}{3}$ inches, and so on. One would have thought that the sizes would increase by one quarter of an inch at a time, but the barleycorn has held its place to the present day.

The palm, which was originally composed of 4 digits or finger breadths, and, since the time of the Romans, of 3 inches or thumb breadths, is no longer used in England, and its place has to a certain extent been taken by a measure called the hand, composed of 4 inches and employed in measuring the height of horses.

Prior to the thirteenth century, the length of the foot in England was uncertain; but, by the ordinance known as the Statute for Measuring Land, enacted in the reign of King Henry III., the relations of the inch, the foot, and the cubit to one another were definitely fixed, and have never since been altered. The cubit of this statute is the double cubit, afterwards called the yard. A translation of the Latin words of the statute, describing the different measures, is as follows:—

"It is ordained that 3 grains of barley, dry and round, make an inch; 12 inches make a foot; 3 feet make a cubit; $5\frac{1}{2}$ cubits make a perch; 40 perches in length and 4 perches in breadth make an acre.

"And it is to be remembered that the iron cubit of our Lord the King contains 3 feet and no more; and the foot must contain 12 inches, measured by the correct measure of this kind of cubit; that is to say, one thirty-sixth part of the said cubit makes one inch, neither more nor less. And $5\frac{1}{2}$ cubits, or $16\frac{1}{2}$ feet, make one perch, in accordance with the above-described iron cubit of our Lord the King."

It is interesting that, in this statute, the double cubit, thus accurately described, should have been called the cubit of the King, just as the longer cubits of Babylon and of Egypt were called Royal cubits to distinguish them from the shorter cubits of those countries. In the Latin original of the ordinance the word used is "ulna," the usual word for cubit. The word "yard," to signify the English double cubit, occurs for the first time in the laws of England in a statute of 1483, which is written in French.

The two measures, the acre's breadth, afterwards called the chain, and the acre's length or furlong, have also been used from a very early period. The former is equal to 44 single cubits, 22 yards, or 66 English feet, while the latter is exactly ten times this, 440 cubits, 220 yards, or 660 feet. The furlong is the modern representative in our system of the ancient stadium, which had a length of 600 Greek feet, or 607·5 English feet, but the reason for its being longer than the stadium has, so far as I know, not been satisfactorily explained. But the change may have been due to the fact that other measures of distance were in use in England prior to the present statute mile, which varied in different parts of the country, and the mean of these was approximately equal to the Gallic league of 12 stadia or 7,290 English feet. One-eleventh of this, 663 English feet, is approximately equal to the English furlong, and eight of these measures, following the Roman system, were combined to form the English statute mile.

But whether this is the origin or not, there appears little doubt that the mile, furlong, and chain, or acre's breadth, were in use in England in Anglo-Saxon times, as there is a law of King Athelstane, who reigned A.D. 925–940, in which it is enacted:—

"Thus far shall be the King's grith from his burgh gate where he is dwelling, on its four sides; that is three miles, and three furlongs, and three acres' breadths, and nine feet, and nine palms, and nine barleycorns."

The length of the measure called the King's grith, or King's peace, was the distance from his house within which peace was to be maintained, and it is evident that in this law an attempt was made to express the distance in terms of ordinary measures.

The terms acre's length and rood are no longer used, and this measure is now known as the furlong, while the acre's breadth has been called the chain since the beginning of the seventeenth century, when it was divided into 100 links instead of 66 feet. The chain, which was the invention of Prof. Gunter, has proved very convenient for the measurement of land acres, and is now always used.

Since the introduction of the chain, the perch or rod has been less employed in connection with land measures, but is still used by builders for the measurement of brickwork. The common English stock brick is half a cubit in length, one-quarter of a cubit in width, and one-sixth of a cubit in thickness, or rather less than these dimensions, to allow for the thickness of the mortar joints, while a rod of brickwork, which one rod or 22 bricks in length, one rod or 66 bricks in height, and three bricks in thickness. The perch or rod of brickwork contains 4356 bricks.

The English sea mile is exactly the same as the geographical mile of the Babylonian system, and its tenth part, the cable length, is identical with the stadium. In these measures there has been no change, and the only difference is that the cable length is 405 English cubits, whereas the stadium was 400 original cubits.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The next combined examination for entrance scholarships and exhibitions, at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges, will be held on Tuesday, December 5, and following days. Mathematics and natural sciences will be subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical science to compete for scholarships and exhibitions by taking the papers set in mathematics and natural sciences. A candidate for a scholarship or exhibition must not be more than nineteen years of age on October 1, 1916. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges.

Mr. S. W. Cole, of Trinity College, has been appointed University lecturer in medical chemistry, and Mr. C. S. Gibson, of Sidney Sussex College, has been appointed assistant to the professor of chemistry; both appointments are for five years.

The Smith's prizes are awarded to H. M. Garner, St. John's College, for two papers on orbital oscillations about the equilateral triangular configuration in the problem of three bodies, and to G. P. Thomson, Corpus Christi College, for four papers on aeroplane problems. A Rayleigh prize is awarded to W. M. Smart, Trinity College, for an essay on the libration of the Trojan planets.

The General Board of Studies does not propose to appoint a lecturer in animal embryology to succeed the late Dr. R. Assheton, and advises that the balance of the benefaction to the lectureship should be used for the completion and publication of the embryological work upon which Dr. Assheton was engaged.

OXFORD.—The Committee for Geography will shortly proceed to the appointment of a reader in geography at a stipend of 300*l*. a year. The reader will also hold the post of director of the School of Geography at an additional stipend of 200*l*. a year. The appointment is for five years from October, 1916, and the holder of the post will be re-eligible. Candidates are requested to send in their applications, with such evidence of their qualifications as they may desire to submit, to the assistant registrar, University Registry, Oxford, so as to reach him not later than Wednesday, May 31. Six copies of the application, and of testimonials, should be sent, and at least one copy of any published work to which it is desired to direct the attention of the Board of Electors.

THE Board of trustees of the Ohio State University has ratified the proposal made by President W. O. Thompson for the establishment and maintenance of research professorships. According to *Science* the plan provides that men of recognised ability may be relieved from teaching to devote their entire time to scientific research.

THE Education Department of the County Council of the West Riding of Yorkshire has arranged to hold a vacation course for teachers at Bingley Training College from August 2–16 next. The aim of the course is to stimulate teachers and to give them opportunities of studying new methods of teaching various subjects. The following courses will be included among those offered: a course on education, by Prof. John Adams; the teaching of handwork, by Miss Suddards; animal life, by Prof. W. Garstang; and plant life, by Dr. O. V. Darbishire. The syllabus, containing time-tables and full particulars, will be issued shortly, and can be obtained upon application to the Education Department (Secondary Branch), County Hall, Wakefield.

As has already been reported in these columns, the foundation-stone of the new Hindu University at Benares was laid by Lord Hardinge, Viceroy and Governor-General of India, on February 4. The issue of the *Pioneer Mail* for February 12 contains a full account of the function. In his address to the Viceroy, the Maharaja of Durbhanga said the contributions of the people of India to the University funds now amount to close upon one crore of rupees (666,700*l*.), including the capitalised value of the annual grants, sanctioned by ruling princes, to which the Government has added an annual grant of a lakh of rupees (6667*l*.) The site selected for the University covers more than 1200 acres. Twenty-four donors gave a lakh of rupees each. Lord Hardinge, in his speech, pointed out that it is the declared policy of the Government of India to do all within its power and within its means to multiply the number of unversities throughout India, realising that the greatest boon Government can give to India is the diffusion of higher education through the creation of new universities. "Many, many more are needed," he continued, "but the new universities to be established at Dacca, Benares, and Bankipore, soon to be followed, I hope, by universities in Burma and the Central Provinces, may be regarded as steps taken in the right direction." The University is to be a teaching and residential, as contrasted with an affiliating and examining university. It was announced at the meeting that the Maharaja of Jodhpur had endowed a chair of technology to which Lord Hardinge's name is to be attached. In addition to a lump sum grant, the Maharaja has promised an annual grant of 24,000 rupees (1334*l*.) for this purpose.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 9.—Sir J. J. Thomson, president, in the chair.—Prof. J. W. **Nicholson** and T. R. **Merton**: The distribution of intensity in broadened spectrum lines. (1) Using a neutral-tinted wedge the actual distribution of intensity in broadened spectrum lines can be accurately measured. (2) With this arrangement quantitative measurements of the hydrogen line $H\alpha$ have been made, and quantitative observations of other lines of hydrogen, helium, and lithium. (3) The intensity-distribution of lines, broadened by condensed discharges and at high pressures, does not follow the well-known probability law known to obtain under certain specified conditions. (4) The broadening of $H\alpha$ is symmetrical. (5) The most general characteristic of all the curves obtained is that their curvature is away from the axis perpendicular to the wave-length scale. (6) The existence of more than one component accords with the view that electrical resolution of lines is the origin of their broadening. (7) On the supposition of several components symmetrically distributed about the centre, the only general law consistent with the distribution of curvature is that of a sum of linear exponential terms, one for each component. (8) It is shown that in these circumstances discontinuities in the slope of the curves must occur. Those found in the curve for $H\alpha$ are in quantitative accordance with those expected from available data with respect to electrical resolution. (9) Quantitative observations of $H\beta$, $H\gamma$, and the diffuse series of helium and lithium confirm the view that electrical resolution is the principal cause of the phenomena.—Prof. H. C. **Plummer**: Prof. Joly's method of avoiding collision at sea. This brief note adds nothing to the general principle on which Prof. Joly's method is founded, but aims at greater simplicity, both in idea and practical detail, by introducing the relative speed of the two ships. The speed and course of an approaching ship being communicated by wireless, the relative speed is easily obtained without calculation by a combination of scales, which is, in fact, identical with Prof. Joly's collision predictor. The one ship may then be considered stationary, and the locus of the approaching ship at successive signals becomes a series of concentric circles. In the case of impending collision the rate of approach is a maximum along a radius and equal to the relative speed. Two methods are suggested for comparing the indications of the signals as received with this critical speed, one involving the use of two direct-reading scales, the other an equivalent arithmetical operation of the simplest kind.—Prof. W. G. **Duffield**: Apparatus for the determination of gravity at sea. The development of the form of apparatus as finally adopted is described. It depends upon balancing a column of mercury against the pressure of a constant volume of air contained in a bulb. The whole apparatus is maintained at as constant a temperature as possible. The height of the column varies inversely as the value of gravity. The apparatus was tested on a voyage to Australia and modified in Adelaide in accordance with experience gained. It was further tested during part of a return voyage under very unfavourable conditions; nevertheless, the results indicate the suitability of this type of instrument for future observations of gravity at sea.

Geological Society, February 23.—Dr. Alfred Harker, president, in the chair.—H. **Dewey**: The origin of some river-gorges in Cornwall and Devon. In North Cornwall, near Tintagel, there is an area of peculiar topography characterised by the presence of an upland plain or plateau. This plateau is dissected by deep gorges, with their walls scarred by potholes through

which the rivers flow in a series of waterfalls, cascades, and rapids. This plateau is terminated inland by degraded cliffs rising abruptly from 400 ft. above sea-level, while the plain slopes gently to the recent sea-cliffs, mostly more than 300 ft. high. The plateau has been cut across rocks of different degrees of hardness, and is overlain by deposits of detritus and peat. Wherever the plain occurs, the scenery is featureless, and the land boggy and waterlogged. The widespread occurrence of this plain over Cornwall and Devon at a uniform height suggests that in its final stages it was a plain of marine erosion. There are in Cornwall and Devon two characteristic types of scenery, to which in great part these counties owe their charm. Wide featureless plains covered with heath and marshland and dominated by tors and crags, on which the drainage is sluggish and vague, alternate with deeply-incised rocky ravines where rivers flow as rapids and cascades. These two types mark successive periods of erosion. Post-Pliocene uplift gave such increased cutting-power to the rivers that they quickly incised chasms in their former valleys, employing while so doing the activity of waterfalls and rapids.

Linnean Society, March 2.—Prof. E. B. Poulton, president, in the chair.—Dr. J. D. F. **Gilchrist**: Larval and post-larval stages of *Jasus lalandii* (Milne-Edwards). Dr. Gilchrist recalls his description, in Journ. Linn. Soc., October, 1913, of the newly-hatched larva, to which he applied the term *naupliosoma*. He now recognises that this name was rather inappropriate, since it tends to obscure the reasonable presumption that the *nauplius* stage has "been passed long before in the development of the embryo." By a record of the distribution, he makes it fairly certain that the further stages of development with which he deals really belong to *Jasus lalandii.* It should, however, be mentioned that, whatever the predominance of this particular crawfish at the Cape, the Atlantic is in some parts well provided with various members of the families Scyllaridæ and Palinuridæ.—B. M. **Griffiths**: The August Heleoplankton of some North Worcestershire pools.—Dr. O. **Stapf**: The distribution of the box-tree, *Buxus sempervirens,* Linn. The author adopted Dr. Christ's views as to the character of the box as a relict of the Tertiary flora of southern Europe, and the discontinuous distribution as brought about by disintegration of an old continuous and much larger area. But he could not share his view that the isolated stations in western France are generally due to old plantations around castles and monasteries. He considered them like the English stations as relict stations.

Mathematical Society, March 9.—Sir Joseph Larmor, president, in the chair.—Major P. A. **MacMahon**: Some applications of general theorems of combinatory analysis.—Prof. H. F. **Baker**: Mr. Grace's theorem on six lines with a common transversal.—H. E. J. **Curzon**: The integrals of a certain Riccati equation connected with Halphen's transformation.—Miss Hilda P. **Hudson**: A certain plane sextic.—Dr. W. P. **Milne**: The construction of coapolar triads on a cubic curve. —J. **Proudman**: The dynamical equations of the tides.

MANCHESTER.

Literary and Philosophical Society, February 22.—Prof. G. Elliot Smith, vice-president, in the chair.—Prof. W. W. Haldane **Gee**: Bunsen and luminous flames. A small obstacle placed at the centre of a coal-gas flame (issuing from a small circular nozzle) at a critical distance above the aperture, gives rise to a musical note of high frequency. If two such flames are made to impinge, roaring or musical flames result. Burners of the Bray and Méker type possess special properties. One experiment of great interest enabled the eddy currents produced by a flame from a triple nozzle to be studied. When the flame is adjusted—so as to be central within a wide glass tube—carbonaceous particles are precipitated from the flame, and these are whirled in an infinite variety of curves round the flame mantle. The effect is more marked when benzine is introduced into the coal-gas.—Dr. J. H. **Smith**: A *résumé* of work on the bleach-out process of colour photography. Grothus, in 1819, seems to have been the first to attempt to formulate the nature of the action of lights of different colour upon bodies, and showed that coloured bodies faded most rapidly in the "opposed" (complementary) coloured light to their own. Liesegang, in 1889, first proposed to utilise this principle in the case of the bleaching-out of aniline dyes in their complementary coloured lights for the production of coloured prints upon paper from transparent coloured pictures. Vallot, in 1895, Neuhaus and Worel, in 1902, and later Szczepanik and the author worked practically upon this process, overcoming some of its difficulties, and obtaining certain results of a somewhat crude nature. In 1907 the author brought the first bleach-out paper upon the market; and in 1911 he was successful in bringing out a new paper ("Utocolor"), by means of which good prints from autochrome plates could be obtained. The more recent work of Limmer, Gebhart, and Just was reviewed.

DUBLIN.

Royal Dublin Society, February 22.—Prof. Sydney Young in the chair.—Prof. Wm. **Brown**: The subsidence of torsional oscillations of nickel wires when subjected to the influence of transverse magnetic fields up to 200 c.g.s. units. A direct transverse magnetic field of 200 c.g.s. units has no effect on the damping of torsional oscillations of a nickel wire whether the wire be hard or soft, but an alternating transverse magnetic field of the same strength increases the damping by almost 10 per cent. in a soft wire and by about 4 per cent. in a hard wire. For a transverse alternating magnetic field of 65 units, it was found that when the frequency of the field was increased eight times the damping was decreased, that is, the amplitude of the seventieth vibration was increased about $4\frac{1}{2}$ per cent.

Royal Irish Academy, February 28.—Rev. J. P. Mahaffy, president, in the chair.—J. J. **Nolan**: The mobility of the ions produced by spraying distilled water. When distilled water is passed through a sprayer the larger drops have a positive charge of uniform surface density, as shown in a previous paper. The present paper deals with the mobility of the ions carried away in the air from the sprayer. Twelve groups of ions have been found, each group possessing a distinct mobility which changes little with time. The mobilities are 0·00038, 0·0010, 0·0043, 0·013, 0·046, 0·12, 0·24, 0·53, 1·1, 1·56, 3·27, and 6·5 cm. per second in a field of 1 volt per cm. Ions of both signs occur in all the groups with the exception of the group of mobility 6·5, which has only been found with negative charges. The negative charge carried by the ions exceeds the positive, the excess being greater in the case of the more mobile ions.—J. A. **McClelland** and P. J. **Nolan**: The nature of the ions produced by bubbling air through mercury. The mobility of the ions carried away in air which has bubbled through mercury has been measured. The mobility decreases rapidly with time, and in this respect differs from the results obtained in the above paper on the spraying of water. When sufficient time has elapsed constant mobilities are reached, and groups of ions have been found corresponding to the first five groups in the above paper. When measured earlier greater mobilities are found,

but the ratios of the mobilities are practically the same as when the stable state has been reached. When the air is dried higher values are again found, and in this case also the ratios of the mobilities have the same values.

PARIS.

Academy of Sciences, February 28.—M. Camille Jordan in the chair.—The President announced the death of Richard Dedekind, and gave a short account of his contributions to mathematics.—Paul **Appell**: Certain polygons the summits of which describe algebraic curves, and of which the sides envelop algebraic curves.—C. **Guichard**: Plane networks which, in an infinity of ways, may be considered as the orthogonal projection of the lines of curvature of a surface.—MM. **Tarazona** and **Marti**: Observation of the eclipse of the sun of February 3, 1916, made at Valencia (Spain). Only the first contact could be observed.—E. **Goursat**: The class of certain differential expressions.—T. H. **Gronwall**: Deformation in conformal representation under restrictive conditions.—B. **Jekhowsky**: The Bessel functions of several variables expressed by Bessel functions of one variable.—Gaston **Julia**: The reduction of positive quadratic forms.—P. **Alexandroff**: The power of measurable ensembles B.—Lucien **Vallery**: The stability of hypochlorites in very dilute solutions. Consequences from the point of view of their use for the sterilisation of water (javelisation). A study of solutions of hypochlorite containing from one to five parts per million of active chlorine. The velocity of decomposition is affected by the medium in two ways, one purely catalytic, the other chemical, depending upon the presence of substances capable of reacting with the molecule of the hypochlorite or with its decomposition products.—G. A. **Le Roy**: The detection of free chlorine in town water supplies. A disagreeable taste becomes perceptible when the amount of active chlorine reaches 0·05 part per million, and chemical control for solutions of such dilution presents difficulties. It is suggested that the active chlorine be concentrated by partial freezing of the water. Starting with 10 litres of water, and freezing 9·8 litres, the remaining liquid readily gives the iodide of starch reaction; 0·0005 milligram of active chlorine per litre can be detected.—Louis **Gentil**: The structure of the Middle Atlas (Central Morocco).—N. **Arabu**: Studies on the Tertiary formations of the basin of the Sea of Marmora.—M. **Deprat**: The existence of a fold of Palæozoic age between Yunnan and Tonkin.

WASHINGTON, D.C.

National Academy of Sciences, (Proceedings, No. 2, vol. ii.).—J. A. **Harris**: Personal equation and steadiness of judgment in the estimation of the number of objects in moderately large samples. While there is no certain differentiation among the experimenters in personal equation, they differ distinctly in steadiness of judgment. The latter is conspicuous in contrast with the former in that it is unmistakably influenced by previous experience.—T. B. **Johnson**: Polypeptide-hydantoins. The formulas for a large number of polypeptide-hydantoins are set up. Some of these substances have already been synthesised and methods for synthesising others are being developed.—J. N. **Rose**: Recent explorations in the cactus deserts of South America. Large collections of cacti in South America have been made, including many species which have never before been collected, and some which, though collected, have been poorly described or wrongly classified.—H. N. **Russell**: The albedo of the planets and their satellites. A table is given of the values finally derived for the albedo of the various planets and satellites. The values are in agreement with the current views of the constitution of the bodies. The value for the earth is intermediate between those of cloudy and cloudless plants.—R. A. **Millikan**: Quantum relations in photo-electric phenomena. So far as experiment has thus far gone Einstein's equation seems to be an exact statement of the energies of emission of corpuscles under the influence of light waves. Thus the correctness of the quantum theory and the reality of Planck's h are corroborated.—J. H. **Ellis**: The chemical activity of the ions of hydrochloric acid determined by electromotive force measurements. In this paper are presented accurate measurements of the electromotive force at 18, 25, and 35° of voltaic cells of the type H_2, HCl, Hg_2Cl_2+Hg, with the acid-concentration varying from 0·03–4·5 normal. From the data are calculated the energy effects attending the reaction which takes place in such cells and those attending the transfer of hydrochloric acid in aqueous solution from one concentration to another. From these results are then calculated the chemical activities (or effective concentrations) of the ions of the acid. These activities are shown to decrease with increasing concentration much more rapidly than do the ion-concentrations derived in the usual way from the electrical conductance ratio.—E. G. **Conklin**: Effects of centrifugal force on the polarity of the eggs of Crepidula. It is difficult, but not absolutely impossible, to change the polarity of eggs and cleavage cells, and the persistence of polarity and the restoration of dislocated parts to normal condition is connected with a somewhat resistent framework of protoplasmic strands.—D. L. **Webster**: The emission quanta of characteristic X-rays. To excite any characteristic radiation it is necessary to use a potential above a critical value. The lines all increase in the same ratio for any given increase of potential. There is reason to believe that the characteristic rays are always a result of excitation of higher-frequency oscillators.—T. W. **Vaughan**: The results of investigations of the ecology of the Floridian and Bahaman shoal-water corals. The ability of corals to remove sediment from their surfaces, their mechanism for catching food, their carnivorous nature, their relation to light and temperature, and so on, have been studied.—C. D. **Walcott**: Cambrian trilobites. Data have been assembled to aid in clearing up some of the problems of formations of the Appalachian region by a careful comparison of portions of their contained faunas with those of other localities.—G. E. **Hale** and F. **Ellerman**: The minute structure of the solar atmosphere. The minute structure of the quiescent solar atmosphere resembles that of the photosphere. The results apparently support the hypothesis that the solar atmosphere consists of parallel columns of ascending and expanding gases, but such questions as the dimensions of the columns and the direction of motion and velocity are reserved for subsequent discussion.—R. W. **Wood**: Monochromatic photography of Jupiter and Saturn. The variation of the appearance of Saturn and Jupiter when photographed with light of different wave-lengths suggests a mist or dust in the planet's atmosphere which scatters the shorter wave-lengths.

BOOKS RECEIVED.

Elements of Highway Engineering. By Prof. A. H. Blanchard. Pp. xii+514. (New York: J. Wiley and Sons., Inc.; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

Aircraft in War and Peace. By W. A. Robson. Pp. xi+176. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*. net.

Individuality in Organisms. By C. M. Child. Pp.

x+213. (Chicago: University of Chicago Press; Cambridge: University Press.) 5s. net.

Notes on the Fenland. By Prof. T. McKenny Hughes, with a description of the Shippea Man. By Prof. A. Macalister. Pp. 35. (Cambridge: At the University Press.) 6d. net.

The Gravels of East Anglia. By Prof. T. McKenny Hughes. Pp. 58. (Cambridge: At the University Press.) 1s. net.

Theosophy and Modern Thought. By C. Jinarājadāsa. Pp. 171. Adyar, Madras: Theosophical Publishing House.) 2s.

Department of Mines and Geology, Mysore State. Records, vol. xiv., 1915. Part 1, Annual Report for the Year 1914. Pp. 59. (Bangalore: Government Press.) 1 rupee.

Records of the Survey of India. Vol. vi. Completion of the Link connecting the Triangulations of India and Russia, 1913. Prepared under the direction of Col. Sir S. G. Burrard. Pp. 115. (Dehra Dun: Trigonometrical Survey.) 6s.

Nutritional Physiology. By P. G. Stiles. Second edition. Pp. 288. (Philadelphia and London: W. B. Saunders Co.) 6s. net.

An Introduction to Neurology. By Prof. C. J. Herrick. Pp. 355. (Philadelphia and London: W. B. Saunders Co.) 7s. 6d. net.

Examples in Alternating-Currents for Students and Engineers. By Prof. F. E. Austin. Vol. i. Second edition. Pp. 223. (Hanover, N.H.: F. E. Austin.) 2.40 dollars.

Surgery in War. By Major A. J. Hull. Pp. xv+390. (London: J. and A. Churchill.) 10s. 6d. net.

The British Freshwater Rhizopoda and Heliozoa. By J. Cash and G. H. Wailes. Vol. iii., Rhizopoda. Part iii. By G. H. Wailes. Pp. xxiv+156+plates xxxiii–lvii. (London: Ray Society; Dulau and Co., Ltd.) 12s. 6d. net.

The Principles of Plant-Teratology. By W. C. Worsdell. Vol. i., pp. xxiv+269+xxv plates. (London: Ray Society; Dulau and Co., Ltd.) 25s. net.

The Physical Properties of Colloidal Solutions. By Prof. E. F. Burton. Pp. vii+200. (London: Longmans and Co.) 6s. net.

Hydraulic Flow Reviewed. By A. A. Barnes. Pp. xi+158. (London: E. and F. N. Spon, Ltd.) 12s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 16.

ROYAL SOCIETY, at 4.30.—Preliminary Report on the Purbeck Characeæ: C. Reid and J. Groves.—Notes on the Genus Toxoplasma, with a Description of Three New Species: Prof. H. G. Plimmer.—The Convolutional Pattern of the Brains of Identical Twins: a Study on Hereditary Resemblance in the Furrows of the Cerebral Hemispheres: F. Sano.

ROYAL INSTITUTION, at 3.—Organic Products used as Propulsive and Explosive Agents Prof. H. E. Armstrong.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Possibilities in the Design of Continuous-current Traction Motors: N. W. Storer.—The Use of Direct Current for Terminal and Trunk Line Electrification: N. W. Storer.

LINNEAN SOCIETY, at 5.—Resemblance between African Butterflies of the Genus Charaxes: a New Form of Mimicry: Prof. E. P. Poulton.—Notes on Plants collected in Sikkim, including the Kalimpong District: C. C. Lacaita.—Exhibition of Species of Ribes and their Garden Derivation: E. Banyard.—Early Botanical Exploration of North America: B. Daydon Jackson.

CHILD STUDY SOCIETY, at 6.—The Unconscious Mental Life of the Child: Dr. E. Jones.

FRIDAY, MARCH 17.

ROYAL INSTITUTION, at 5.30.—The Search for New Coal Fields in England: Dr. A. Strahan.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Composition of the Exhaust from Liquid-fuel Engines: R. W. Fenning.

SATURDAY, MARCH 18.

ROYAL INSTITUTION, at 3.—Radiation from Atoms and Electrons: Sir J. J. Thomson.

MONDAY, MARCH 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Military Geography of the Troad: Dr. W. Leaf.

ARISTOTELIAN SOCIETY, at 8.—Symposium "Recognition and Memory": Miss Beatrice Edgell, F. E. Bartlett, Dr. G. E. Moore, and Dr. H. W. Carr.

VICTORIA INSTITUTE, at 4.30.—Inscriptions and Drawings from Roman Catacombs: Rev. H. E. Fox.

TUESDAY, MARCH 21.

ROYAL INSTITUTION, at 3.—Sea Power as a Factor in the Evolution of Modern Races: Prof. A. Keith.

ZOOLOGICAL SOCIETY, at 5.30.—Results of Mendelian Cross in Fowls: J. T. Cunningham.—Structure of the Alisphenoid Canal in some Civets and Hyænas: R. I. Pocock.—Observations on the Cytology of Flagellates and Amœbæ obtained from Old Stored Soil: Dr. T. Goodey.—Notes on the Sitatunga or Marsh-Antelope of the Sesse Islands: Major R. Meinertzhagen.

ILLUMINATING ENGINEERING SOCIETY, at 5.—*Discussion:* Some Aspects of the Design and Use of Glassware in Relation to Natural and Artificial Illumination.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Rangoon River-Training Works: Sir G. C. Buchanan, C.I.E.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Valedictory Address by the President, Sir Boverton Redwood.—The Natural Gas Industry, its Progress and Importance: Dr. J. A. Leo Henderson.

MINERALOGICAL SOCIETY, at 5.30.—An Improvement in the Methods of Determining the Refractive Indices of Minerals under the Microscope: Dr. J. W. Evans.—A Butterfly-twin of Gypsum: L. J. Spencer.

ROYAL STATISTICAL SOCIETY, at 5.15.—War Finance: Sir George Paish.

WEDNESDAY, MARCH 22.

GEOLOGICAL SOCIETY, at 5.30.

THURSDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Organic Products used as Propulsive and Explosive Agents: Prof. H. E. Armstrong.

FRIDAY, MARCH 24.

ROYAL INSTITUTION, at 5.30.—The Mechanism of Chemical Change in Living Organisms: Prof. W. M. Bayliss.

SATURDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

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THURSDAY, MARCH 23, 1916.

THE BUDGET OF PARADOXES.

A Budget of Paradoxes. By A. de Morgan. Second edition, edited by D. E. Smith. Two volumes. Vol. i., pp. viii+402; vol. ii., pp. 387. (Chicago and London: The Open Court Publishing Co., 1915.) Price 30*s.* net.

THIS is not the first time the Open Court Co. has deserved grateful thanks for undertaking a reprint of a rare work, although they will probably make no profit out of it. The editor, well known as a writer on the history and teaching of mathematics, has laid down for himself an excellent plan, namely, to preserve the text intact, except where mistakes could be corrected with certainty; to indicate clearly the authorship of every addition or alteration; to add catchlines to break up the text; and to give notes for the information, not only of mathematicians, but of those who treasure the "Budget" as a literary work of art, and who, even when well-read, may be puzzled by the numerous quotations and allusions in which De Morgan delights. To produce an annotated edition of this kind is a very difficult task; it would require another De Morgan to perform it to perfection, and we thank Prof. Smith for what he has done, without dwelling ungraciously upon what he has omitted, or blundered in trying to do.

First of all we may say that the biographical notes are abundant (too much so, some may think); so far as they refer to mathematical writers, they are generally appropriate, and so far as we have tested, are accurate. To end up a ten-line note on Rowan Hamilton with the sentence "He also wrote on dynamics" irresistibly reminds us of that other casual after-thought "and the stars also" in Gen. i. 16. Here, as elsewhere, the editor's humour is of the unconscious kind; and one instance is so funny that we really cannot pass it over. The Religious Tract Society (see i. 194) censored a perfectly harmless passage in one of Hannah More's tales which they were reprinting. On this De Morgan: "O fie! Miss Hannah More! and you a single lady too, and a contemporary of the virtuous Bowdler!" Editorial comment: a note on Henrietta Maria Bowdler, and not a word about the immortal Thomas! Again, by confusing "Tom" Sheridan with the elder Thomas S., the editor has found one of the most wonderful mare's-nests on record (i. 175).

In giving translations of quotations, etc., in the text Prof. Smith is sometimes painfully inaccurate, and in other cases he is unsympathetic. As an instance of what we mean, take i. 40, where we read: "the answer is—

"Rumpat et serpens iter institutum

—a line of Horace [Carm. iii. 27], which the demons interpret as a direction to come athwart the proceedings of the Institute by a sly trick." If we are to have a translation here, the best would be a mock-translation, such as "And let the Old Serpent interrupt the proceedings of the Institute," like De Morgan's "change dice into coin" for *mutat quadrata rotundis,* where the editor gives no reference to the original context (possibly to spare the feelings of a certain class of millionaires). To return to the present case, the editor's rendering is "Let the serpent also break from its appointed path," which is incorrect, and neither suits the original context nor the one to which De Morgan applies it. (And we might have had, instead of this blunder, a brief note on the *Institut national.*)

The list printed below[1] contains corrections of errors we have found, which are serious enough to be actually misleading; perhaps the Open Court Co. might be willing to have them tested, and then pasted as *corrigenda* in some at least of the copies of this edition.

Prof. Smith has adopted a system of what he calls "slightly modernised spelling." If, in his notes, he likes to print "equaled" (why not "equald," like "herald" and "ribald," while we are about it?) he has a perfect right to do so; but we respectfully protest against his taking this liberty with the text. And is *dilletante* a misprint, or an example of modernised spelling?

To us, the one great failing of Prof. Smith, as an editor, is that he has treated the "Budget" (naturally enough, from his point of view) too much as a chapter in the history of mathematics, or rather of pseudo-mathematics. Really, it is a study of a class of cranks (who are always with us), and, as such, it is a section of the great Book of Human Folly and Self-Conceit. Incidentally, of course, it gives a portrait of the author, who was a very remarkable man. No mean mathematician, he was an excellent teacher of his subject (we ourselves knew one of his pupils); he was an expert in formal logic; an antiquarian and humorist like Walter Scott, a scholar and a wit like Sydney Smith. (His digression, ii. 22, suggested by the paradox of the moon's rotation, is so like an essay by Sydney Smith that if candidates in an examination on English literature were given a selected passage from it, and asked to name its author, the intelligent ones would be very likely to ascribe it to S. S., that imperishable ornament of the English Church). Handicapped by that wretched name Augustus, he made it one of the few exceptions to a general rule. Like Augustus among the

[1] In i. 4 Kleckermanno should be Keckermanno; *Cl.* means *Claro*, and should have been translated (the reference appears to be to Bartholomew K.): next p., *veritate* should be *veritati*; *quamvis eo nomine non multum gratiae iniverit* means "although he (K.) has not found much favour on that score"; i. 7 "unprovoked" *l.* "unproved"; (i.) 13 *l.* "Merchant Taylors'"; 73 (end) *l.* "the Moors that we see (among ourselves)"; 104 *l. prave* (the passage is from Phædrus); 127 "work" *l.* "word"; 175, "Tom Sheridan" means the only son of the playwright (R. B. S.), and there are no chronological difficulties about the story, whether it be true or not; 194 the reference is to Thomas Bowdler and his famous edition of Shakespeare; 204 the book referred to is the "Trigonometry and Double Algebra"; 241 Revilo means Oliver Byrne (*v.* i. 329); 299 Slow = Slough, and printing "Dr. Heirschel at Slow" would have made things clearer: 302 for "quib" *l.* "squib." In ii. 2, *l.* "I *had* no need for that hypothesis"—to render *avais* by "have" misrepresents Laplace; 4 (end) "sorest" is probably a misprint for "worst"; 15 (top) for "At least" *l.* "At last"; 31 'L' should be 'L (with ' for the *spiritus asper*); the new editor has spoiled the joke, such as it is: 73. *Pansées*, *l.* *Pensées*; 136 (*n.*) "condemned" should be "thought negligible"; 166 *a cru devoir* = "fancied himself obliged," and *gratuitement* = 'gratuitously'; 225 (end) the second "goals" should be "gaols"; and "sums" (just above) should be "sum."

Roman Emperors, he was distinguished by his all-round ability and common-sense; a lover of peace, he conquered whenever he fought, and was clement to the vanquished. In his quotations and references he is not always exact, but he is eminently trustworthy. If he cites a tag from Horace (often, undoubtedly, from memory) it generally agrees with some respectable text; if he says that such-and-such a book was published at such-and-such a place at such-and-such a date, his information is pretty sure to be substantially accurate (*e.g.*, take the case, i. 66), because he knew the trouble caused by "slipslop" references.

His weakest point was a passion for acrostics, anagrams, *et hoc genus omne;* he simply cannot resist the chance of airing it, as when he says about the theory of gravitation that for Newton it was *not new,* but he *went on.* One of the many puzzles of the "Budget" appears on the title-page in the form:—

"UT AGENDO SURGAMUS, ARGUENDO GUSTAMUS."
—PTOCHODOKIARCHUS ANAGRAMMATISTES.

His own explanation of the motto is on i. 138–9. One of his friends seems to have shared his anagrammania; but for this, and his reference to him as a "powerful mathematician," we should have had little hesitation in ascribing this anagram to De Morgan himself. Even yet we have some inclination that way, because "powerful" is ambiguous, even when applied to a mathematician; and De Morgan was no weakling, either in the physical or in the metaphysical sense. *Ptochodokiarchus* looks like a misprint (or slip of the pen) for *Ptochodochiarchus,* because there is a rare Greek word, πτωχοδοχεῖον, which appears to mean some sort of charitable institution. Thus the term might be applied to the master of a workhouse, or the Governor of Chelsea Hospital; but neither of these officials is likely to be a "powerful mathematician" in the ordinary sense.

Here the demon of anagram (=the man of A. De Morgan) suggests to us that Augustus De Morgan=August Sugar-demon; but this is mere child's play with sugar-plums, and we prefer *A snug modest augur,* one that (to revive an old pun) is never a bore.

It is a disgrace for any mathematician not to know of the existence, and general object, of the "Budget," and in writing this review we have acted on that assumption throughout. But to a reader in sympathy with the author, this book ought to be what Burton's "Anatomy" was to Samuel Johnson: the one work that would make him get out of bed before he intended. To take only a few examples: we have references to aviation (ii. 9: here Prof. Smith has a touching, appropriate, and illuminating comment, "The notes on this page were written on the day of the funeral of Wilbur Wright, June 1, 1912, the man who realised all of these prophecies, and then died a victim of municipal crime—of typhoid fever"); to wood-pulp paper; to plans for a universal language (i. 116); to the improbability of Christians sinking their differences (ii. 23), which suggests to De Morgan "the floor of the bottomless pit"; to the science (as we may fairly call it now) of meteorology; to the duties of an editor (of a journal or a book, as the case may be).

A friend of ours has expressed the opinion that no account of De Morgan is complete without some reference to his controversies with Sir William Hamilton (of Edinburgh). This is not the occasion for attempting to give a complete account of De Morgan; suffice it to say that in this matter he generously buried the hatchet, and that when he twits his opponent with discovering two things which are identical, yet one is greater than the other, he refers to the famous theory of the quantification of the predicate.

There are one or two cases where the editor has given us no information, although a comment would have been valuable and easily supplied. One of the features of this edition is that it gives us two portraits of De Morgan (both, apparently, reproduced from photographs). We are not told what the originals were, or the age of the sitter on each occasion. In the preface to the former edition Mrs. De Morgan refers to omissions made by herself from the text as it appeared in the *Athenaeum.* Among these is a "rather large" one on a quarrel about the telescope at Campden Hill, and Mrs. De Morgan looks forward to its insertion in a future edition. We have not been able to find it in this one; indeed, there is no evidence that Prof. Smith has consulted the *Athenaeum* at all.

One other case will appeal to all who, like us, regard University College, London, as their real *alma mater.* De Morgan says, "Some of the pupils of University College, in which all subdivisions of religion are (1866; *were,* 1867) on a level." The reader might infer that the original charter of U.C. had either been altered or infringed. This is not so; the fact is that an eminent Unitarian candidate for a chair was rejected, and De Morgan chose to think (rightly or wrongly) that this was due to religious prejudice, though, of course, no such reason was ever admitted by the electors.

We conclude with a quotation from the "Budget" which, at any rate, is opportune, and we fear has by no means lost its point (i. 289).

"So far as Mr. Goulburn was concerned, the above was poetic justice. He was the minister who, in old time, told a deputation of the Astronomical Society that the Government did not care twopence for all the science in the country."

Later on, De Morgan says (1866, or so), "Matters are much changed"; thanks in great measure, *we* may add, to that German and English patriot, the Prince Consort. But are they *now* (1916)? and if so, *how*? We have seen it stated in print, and not contradicted, that one of our Government's experiments in economy has been to shut up the library of the Patent Office—the one first-class scientific library in London to which everyone has access, though it is hidden in a corner, and few there be that find it. "Patriots" are for tabooing every book in the German tongue, though if we could get all their latest books and papers on chemistry, and a first-

rate chemist to study them, we might spoil the Egyptians indeed. England's contempt for science, against which all who know have been protesting for a generation, will, if not amended, bring her down in sorrow to the ground, *whatever the issue of the present war,* which will be followed by one of much greater intensity, for which the weapons will be forged, not by hands, or machines, but by brains. G. B. M.

PHARMACOLOGY.

A Manual of Pharmacology. By Prof. W. E. Dixon. Fourth edition. Completely revised. Pp. xii+467. (London: Edward Arnold, 1915.) Price 15*s.* net.

PROF DIXON'S well-known and popular manual needs no recommendation at this stage of its career. It shows on every page the methods of an experienced and enthusiastic teacher and skilled demonstrator, and it has played no small part in the change, which is transforming the teaching of pharmacology in this country, from a rather profitless recital of materia medica, doses, preparations, and conventionally defined actions, into the reasoned presentation of a progressive, experimental science. The new edition retains the good qualities of its predecessors, and gains by additions to the admirable series of charts and mechanical records which illustrate the argument.

It must be confessed, however, that in some directions the new edition scarcely seems to justify its prefatory claim to have been so largely rewritten "that it almost constitutes a new volume." The last sentence of the preface, indeed, suggests that Prof. Dixon's intended revision may have suffered some forced interruption —as well might happen at a time when all scientific enterprise is liable to curtailment by more urgent national duties. The introduction of certain new sections has not improved the scheme of classification—always a difficulty to the writer of a pharmacological text-book. For example, a short section on "Drugs increasing the excretion of uric acid," now finds itself stranded, as it were by accident, in the midst of a chapter dealing with action on nerve-endings. This and similar anomalies convey the suggestion of a somewhat hurried shuffling of the sections.

But the arrangement of the material is a minor matter, and we attach more importance, as evidence that the writer's intentions have not been fully carried out, to the apparent absence of any addition to, or revision of, the sections dealing with some of the remedial agents, in regard to which knowledge has most conspicuously advanced since the previous edition was published. The use of salvarsan, for example, had scarcely passed beyond the experimental stage in 1912; and the statement that "arsenobenzol is certainly not free from danger, and a considerable number of deaths have followed its injection," was then a justifiable caution. But this same statement does not adequately summarise the experience available in 1915. The discovery of the significance of emetine, in the treatment of amœbic dysentery by ipecacuanha, was probably too late for inclusion in the 1912 issue; but it might reasonably be expected, under normal conditions, that an extensively rewritten edition, appearing in 1915, would make some reference to this very important advance. Yet the statement of the third edition, that ipecacuanha "has also a great reputation in the treatment of tropical dysentery, but its mode of action is unknown," appears in the fourth edition, without modification or addition; and we scarcely suppose that the author intended to leave it so.

In the section on serum therapy, again, we had expected to find some reference to antimeningococcus serum, and to the immune serum against the dysentery bacilli. Both can now show practical results second only to those of the antitoxic sera, and, if want of space were the trouble, we would willingly have forgone in their favour the section on the doubtful antistreptococcic serum, or even what seems to us a not very illuminating attempt to explain antitoxin-formation by an analogy drawn from ferment action.

We take comfort from the conviction that a fifth edition will soon be on the way, and we may be allowed to hope that a calmer state of the general atmosphere will give the author unhampered opportunity for dealing with those sections of his volume, which he has apparently been obliged to pass over in the edition under review. Meanwhile we wish the text-book a continuance of its well-deserved popularity, with student and teacher alike.

OUR BOOKSHELF.

The Wheat Industry for Use in Schools. By N. A. Bengtson and D. Griffith. Pp. xiii+341. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 3*s.* net.

THIS book is the first of a new series called the Industrial Series, which is designed to make use of industrial studies in education. The justification urged for such a course is that these subjects afford useful information, come into line with vocational training, and stimulate interest and clear thinking.

Beginning with an account of the wheat plant and the types in common cultivation, the authors pass on to the methods by which man has succeeded in growing wheat in enormous areas all over the globe. Old and new ways are both described, and the development from the early primitive forms to the present elaborate machinery is carefully traced out. After harvesting and threshing come transportation and storage, and the reader is taken behind the scenes and shown the workings both of small and large elevators in their various ramifications; as, for example, how country roads, wheat crops, and farm and elevator storage are all intimately linked with business operations and social questions generally. Next comes an interesting chapter on the factors in wheat production and the interaction of climate,

soil, insect and fungoid pests, the size of farms, and the use of machinery, etc.

The last section of the book deals with the different wheat-producing countries. Australia is described first, then the Argentine, and next the United States, which has a larger wheat production than any other country in the world; then follows an account of Canada, finally of the European and Asiatic wheat-producing countries.

The illustrations are well chosen and add considerably to the value of the book. Altogether it makes a very interesting volume, which we put down with the feeling that the authors have done their work well and produced something that will be of much value to teachers. E. J. R.

Post-Mortem Methods. By Prof. J. Martin Beattie. Pp. viii+231. (Cambridge: At the University Press, 1915.) Price 10*s.* 6*d.* net.

It is now generally recognised that the diagnosis and scientific treatment of disease must be based on a sound knowledge of the abnormal conditions present in the various organs and tissues in cases of disease.

Such knowledge can only be obtained in the post-mortem room, and it is very important that the examinations should be conducted systematically and by some routine method of procedure. The object of the author of this book has been to set out a definite method of procedure, and such modifications of this procedure which may be demanded by special circumstances. We think that Prof. Beattie has successfully accomplished these aims; the book is thoroughly practical without being too full of detail, and the scheme of examination suggested is a sound one. A chapter is included on post-mortem examination for medico-legal purposes, and another on the examinations required in the various diseases; in this reference is made to the principal tropical maladies. Finally, in an appendix a summary is given of the methods employed for the preparation of museum specimens, the preparation of tissues and sections for microscopical examination, and of bacteriological culture media and stains. The book is illustrated with eight half-tone plates and some figures in the text. R. T. H.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Compiled from official sources. Pp. viii+351. (London: Charles Griffin and Co., Ltd., 1915.) Price 7*s.* 6*d.* net.

This thirty-second issue of a very useful annual work of reference will be welcomed by many workers in science. We notice the inclusion of several new societies, and these additions serve to increase the value of the year-book. The particulars given about the British Association run to some eighteen pages, but they refer to the Australian meeting of August, 1914, no account of the proceedings of the Manchester meeting last September being included, though the particulars have long been available. The volume deserves a place among the reference books in every scientific library.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Liesegang Phenomenon and Concretionary Structure in Rocks.

The curious formations illustrated were produced during some experiments made to support a suggestion that the Liesegang phenomenon might be attributed to adsorption (*Science Progress*, x., 369, 1916). The tubes contained 15 c.c. of 1 per cent. agar gel, in which small quantities of either liver of sulphur or manganese sulphate had been dissolved, and were treated with 10 c.c. of a standard solution of the other reagent. Particularly in the case of the gels containing the polysulphides, the resulting stratification differed from that hitherto observed, in that many of the zones were separated into a number of concretions, which in some instances were joined by rods to those of the succeeding zone. The concretions were

FIG. 1. FIG. 2. FIG. 3.

all sharply defined; the indistinctness of Fig. 2 is due to their being imbedded in the gel. The peculiar structure may be due to the presence in the gel of small nuclei in the shape of deposited sulphur, or possibly to the composite character of one of the solutes. The separate spheroids, once started, would grow by adsorption in the same way as the solid strata. To determine the exact conditions of their formation requires further investigation, but it should be possible to repeat the experiment with the carbonates of calcium and magnesium.

The structures appear closely to resemble the concretionary limestones described by Sedgwick (Trans. Geol. Soc. (2), iii., 1835), Garwood (*Geol. Mag.*, (3), viii., 1891), Abbott (Q. J. Geol. Soc., lix., 1903), and others. Indeed, certain specimens, which Mr. Abbott kindly showed me, appeared identical in detail with the formation of Fig. 3. To one who is not a geologist it is difficult, at first sight, to refuse the conclusion that similar causes have been at work in each case. Silicic acid gels are known to occur in nature. A gel may contain as little as 1 per cent. of silica. Should solutions of calcium and magnesium salts come into contact with a dilute silicic acid gel, containing alkali carbonates, under the proper condi-

tions, it seems probable that such calcareous formations, beneath a stratified layer, would result. The solutes in the gel and in the water might, of course, be interchanged. Since the limestone would be denser than the gel, the proportion of silica contained in the formations would be reduced to a very small figure. The unaffected gel would shrink by loss of water with time, and might eventually be washed away by the action of water containing alkali carbonates in which hydrated amorphous silica is readily soluble.

The zonal structure of some of the concretions themselves might be ascribed to the effect of different rates of adsorption of the mixed solutes in the gel. In the layer immediately surrounding the growing concretion one of the solutes would be exhausted first, allowing the deposition of pure carbonate. By the time the second solute had been completely extracted from the envelope, the precipitation of the first might have recommenced, and so on. The effect of the adsorption on the concentrations of the solutes would be felt at some distance from the adsorbing centres; so that different spheroids might be formed in regions of different concentration. Moreover, the concentrations of the solutes would gradually decrease as precipitation proceeded. This would account for the varying composition of the concretions. None of the arguments quoted by Prof. Garwood (*loc. cit.*) against the stalactitic theory of the origin of these formations appears to be incompatible with an adsorption hypothesis.

S. C. BRADFORD.

The Science Museum, South Kensington, London, S.W., March 9.

International Latin.

THE small band of scientific men who have long been convinced that in Latin we have at hand the best possible universal language for scientific purposes will be gratified to note the matter has recently come to the fore in your columns, though the regrettable cause be the death of an eminent man. The urgent need of an international medium of scientific communication has by now become sufficiently obvious, and has led, not only to the advocacy of Esperanto, but to the manufacture, mainly in Germany and by typically German methods, of yet another "language," understood to be specially aimed at scientific requirements.

It seems desirable to point out some of the advantages of Latin as a latter-day antidote to the curse of the Tower of Babel. These may briefly be classified into the facts: (1) that Latin is to a large extent "on the spot"; (2) that it lends itself quite as well to the purpose in question as any living tongue; and (3) that it is a *language,* a vehicle of thought and style and expression, as distinct from a shorthand written in longhand characters.

(1) Do not let us be influenced by the notion that Latin is a stone-dead language. Written and spoken it survives to this day in the Roman Catholic world. Pharmacy has never given up the use of it. Within living memory the debates of the Hungarian Diet were held in Latin, and in many Continental universities dissertations, scientific and other, were couched in Latin, the use of which remains optional even at the present time. The flame has indeed died down, but there are smouldering embers waiting for the whiff that will kindle it anew.

The vitality of Latin stands on a far surer foundation, however, than one or two picturesque survivals. Is not a greater or less knowledge of Latin the hallmark of every man having some claim to education, whatever his nationality? Our traditional school system of teaching Latin would no doubt have to be modified if readiness in the use of Latin as a medium of communication were the object aimed at (which at present it is not); but even as things are, I venture to think that most of us would find the refurbishing and readjusting of whatever Latin we learnt at school not nearly so difficult as might at first blush be supposed. Knowledge acquired in early youth is a remarkably tenacious thing. Furthermore, it is impossible for an educated man ever to shake off a certain familiarity with Latin, owing to the persistence of Latin words and phrases, and of words derived from Latin, in everyday language.

(2) The principal requisite of a language for scientific purposes is that it should be capable of rendering a wide range of concepts both clearly and concisely. All those modern languages which have been brought into the service of science perform the task of accurate presentation on the whole adequately. One reason for this—possibly the chief reason—is that scientific literature is thickly larded with words and phrases of common international acceptation, and these, we may note, are mainly of Latin or Greek origin. They will fall into their places with the utmost sweetness when Latin is revived. As for conciseness, English, with the simplicity of its inflexions and constructions, perhaps bears the palm, but, it may be feared, rather at the expense of clearness. The very terseness of English often seriously hampers the writer or speaker who would avoid ambiguity. Hence the somewhat richer grammar of Latin is not really in the nature of a defect, and in any case Latin composition makes considerably less demand on the grammatical memory than German or Russian.

Is Latin sufficiently adaptable to modern scientific needs? Surely, yes. Repeatedly Latin has risen admirably to the occasion when applied to a precise and highly technical subject; one need only think of Justinian's "Code" and Newton's "Principia." A great number of new terminological vocables would, of course, have to be added to the limited Latin of classical times, but to assign the proper form, inflexions, and connotation to these words would be an easy task for an international committee, and would incidentally have a most beneficial effect in the direction of clearing scientific parlance generally. Chemistry, it may be mentioned, possesses a ready-made Latin terminology, handed on through the centuries by the pharmacists.

(3) The question must be faced whether we want an international language, like Latin, or an international Pidgin, like Volapuk, Esperanto, Ido, etc. I plead confidently for the former. A true language cannot be made to order; it must be evolved. The various well-meant attempts at artificial "languages," each fully conscious of its predecessors' infirmities, can only be regarded as a succession of experiments—tending to what? We may expect further attempts as time goes on, attempts yet more poverty-stricken, yet more remote from the least approach to amenity, and yet more incapable of expressing anything but bald facts. The logical outcome of the series would doubtless be something not essentially different from the system of algebraical signs, chemical formulæ, and arithmetical figures, which we already have. Language, on the other hand, enables us not only to state facts, but to modulate the statements of facts, to exchange views, to express personality, and so on. Language, moreover, has in itself the power of stimulating understanding and imagination, much as the savour of food stimulates its digestion. Science cannot dispense with notation, but no more can it dispense with language. And if anyone doubts that Latin is equal to any modern tongue in these ampler characteristics of language, let him but read his classics.

The scientific world, then, may do well to consider seriously the revival of Latin as an international

medium, and to do so before it is hustled into the acceptance of some factitious brew of sounds and letters. The universal language, in fine, need not be laboriously sought for. It has been with us all the time, like a neglected tool that we have only to clean of its rust and sharpen. Let us no longer neglect it.

W. A. CASPARI.

CHEMICAL ORGANISATION IN GERMANY DURING THE WAR.

VERY soon after the outbreak of war steps were taken in Germany to organise, control, and develop the supply and manufacture of the materials necessary for chemical industry, especially that part of it most closely connected with the manufacture of munitions of war.

The first interesting sign of this internal activity was the fusion, on August 8, 1914, of the two great industrial associations, the Zentralverband deutscher Industriellen and the Bund der Industriellen, under the title Kriegsauschuss der deutschen Industrie (War Committee of German Industry).

The next step was the formation of a large number of organisations and Zentralstellen, the function of which was the collection, control, and regulated distribution of the whole existing stock of war materials and crude products necessary for industry, especially in its relation to war. Thus were formed the Kriegsmetall Aktiengesellschaft and the Kriegschemikalien Aktiengesellschaft. Before the end of 1914 no fewer than twenty-eight such Zentralstellen had been formed, each dealing with a different kind of material or product. One has also been formed in Brussels for the purpose of taking stock of, and collecting, the available material found in Belgium. It is interesting to note that the German technical journals state quite openly that the Belgian stocks improved in many respects the condition of German industry, which had been somewhat shaken at the outset.

But in spite of this centralisation of control and supply, it appears that a good many difficulties have had to be surmounted. Although large stocks of Chilian nitrate had been collected before the war, the question of the supply of nitric acid was seen to be of vital importance. It appears that the Ostwald catalytic oxidation process (improved by Haber), which had been carried on before the war by the Badische Anilin- und Soda-fabrik at Ludwigshafen (and also by another company at Vilvorde in Belgium), probably on a comparatively small scale, has been very largely extended. The commercial possibility of this depends, of course, on the fact that the Badische company had already developed on an enormous scale the synthetic production of ammonia initiated by the researches of Haber and Le Rossignol.

It must not be forgotten, too, that the manufacture of nitric acid from the air had been already developed in Austria by Pauling. Possibly this or similar processes (*e.g.*, Schönherr-Hessberger) have been extended since the beginning of the war. A significant fact is that the Griesheim-Elektron Company, which had started some years ago the manufacture of nitrogen peroxide in Switzerland, greatly extended these works after the outbreak of war, and sent the product in liquid form to Germany. Nitrogen peroxide is the "raw material" for the manufacture of synthetic nitric acid. It also makes quite good "poison gas." It appears that the nitrogen peroxide was allowed to pass through easily, as, no doubt, a harmless substance like that was not of any importance.

In order to make matters quite sure, the German authorities forbade the use of nitrates in agriculture. E. Haselhoff published an extensive paper giving the relative values as manure of a large number of substitutes for nitrate. Ammonium sulphate was recommended as of equal value, especially if put relatively deep into the soil, and preferably during autumn rather than spring. The value of urea and guanidine and their compounds was also considered, and close attention was given to calcium cyanamide, which is produced in large quantities in Germany. As regards phosphates, which are so important for manure, attention was directed to the deposits in the neighbourhood of Liège and Mons, and to the phosphorites of the Rhine and Lahn districts; also to Thomas phosphate slag.

In connection with the use of calcium cyanamide, the Prussian Department of State for Agriculture issued, at the beginning of 1915, a circular asking for rapid solutions of the following problems, namely: (1) Determination of the value of calcium cyanamide as manure, at the different seasons, for different soils, and for different crops. (2) Improvements in its *Streufähigheit* (capability of being strewn or spread).

For the first, three prizes of 150*l.*, 100*l.*, and 50*l.* were offered. For the second problem a prize of 500*l.* was offered for the devising of a new process, and another prize of 500*l.* if the process be adopted.

The Germans appear to have been obliged to take great precautions to avoid a shortage of sulphuric acid. In time of peace Germany obtains about 80 per cent. of her supply from outside, mainly from Belgium, where it is obtained as a by-product in the roasting of sulphide ores (zinc, lead, iron). But this source must have been practically stopped, in spite of the occupation of Belgium, since the ores treated in Belgium come mainly from Spain, North Africa, America, and Australia. The employment of sulphur can scarcely be feasible, unless Germany has succeeded since the outbreak of war in obtaining sufficient supplies from Italy and America. Swedish ores can, however, be handled, especially by means of mechanical roasters. There are also the Norwegian, Hungarian, and Styrian ores to be reckoned with. There are, however, many evidences that the employment of sulphuric acid has been put under the strictest control and supervision.

The question of substitutes for wheat and rye in the manufacture of bread has been very widely discussed. Amongst the substitutes or additions

suggested may be mentioned barley, potatoes, blood, sugar, etc. Many prominent specialists (*e.g.*, Zuntz, Kobert, Thiele, Neumann, Stokola) have written articles discussing the relative nutritive powers of various types of "composite" bread. Besides the new factories for synthetic ammonia and nitric acid, there is evidence that factories have been installed for the manufacture of aluminium hydroxide and aluminium, but no details have been published; though it is claimed that new methods of working have surmounted the difficulty caused by the want of French bauxite.

In spite of Germany's enormous production of zinc, the refining of the crude metal had not been practised to any considerable extent before the war. It is stated that this is now an established industry in Germany.

Suggestions have been made to avoid the use of sulphuric acid in the manufacture of hydrochloric acid by producing the latter directly by the direct combination of electrolytic hydrogen and chlorine. In order to save sulphuric acid C. Bruder has proposed to extract copper from poor ores by the use of alkaline solutions.

Acetic acid is a very important substance, as it is, for example, the source of acetic anhydride, monochloroacetic acid, and acetone, which are indispensable for the manufacture of drugs, dyes, and explosives.

As the American supply of grey acetate is now failing, suggestions have been made to prepare acetic acid from acetaldehyde obtained from acetylene. There appears to be no shortage of carbide, which is still coming freely from Norway and Switzerland.

Fatty oils and fats are indispensable, and Germany is bound to obtain a large amount from abroad. The Germans have expressed their satisfaction that the fatty oils solidified by the Normann process have been allowed to pass freely in, and have commented on the "fairness" of England in this respect. Stupidity would be, perhaps, a better word. A large amount appears to enter through neutral countries. Thus, according to statistics of Norwegian trade, published by the *Chemiker Zeitung* of August 4, 1915, the export of fatty oils from Norway in 1913 was 348 tons, whereas in 1914 it had risen to 2009 tons. The shortage of fats and oils is obvious, however, from papers such as that published by Bechhold, where it is suggested that all the fats which disappear down the kitchen sinks of Germany should be recovered, the quantity being calculated to be about one and a half million pounds per diem in Germany alone.

As regards the production of hydrogen gas, no doubt for war purposes, it is interesting to note that a single firm, Karl Francke, in Bremen, has erected eight new factories since the beginning of the war, each of which has a daily output of 60,000 cubic metres (more than two million cubic feet).

During the naphtha shortage, caused by the Russian occupation of Galicia, alcohol came somewhat into use as a liquid fuel.

In connection with the use of chlorine as a poison gas, it is interesting to observe the regular appearance in the *Chemiker Zeitung*, from May 29, 1915, onwards, of an advertisement asking for the delivery of 250,000 kilos of liquid chlorine. Also in different issues of the same journal, during the month of July, 1915, there are advertisements asking for the rapid delivery of complete plants for chlorine liquefaction. Interesting also in this connection are requests for delivery of large quantities of bromides, dated December 9, 1914, and March 10, 1915. There are also requests for liquid sulphur dioxide (January 30, 1915) and liquid hydrogen chloride (April 14, 1915).

The *Chemiker Zeitung* (vol. ii., p. 738, 1915) contains a reference to an article by Prof. Leo Vignon, of Lyons, comparing the proportional numbers of chemists in Switzerland, Germany, France, and England in comparison with their respective populations. The relative numbers given are: Switzerland, 300; Germany, 250; France, 7; England, 6. No doubt the low "chemical density" in France and England is a source of undeniable satisfaction to the readers of the *Chemiker Zeitung*. The figures are certainly astonishing, and we would commend them to the attentive consideration of British chemical manufacturers. A perusal of the German journals dealing with the industrial aspects of chemistry gives the impression that there is a pretty severe censorship as regards publication, for little can be gathered concerning the most vital points.

In conclusion I desire to express my best thanks to Dr. F. Schwers, of the University of Liège, who has rendered me valuable aid in the collection of such information as it has been possible to obtain.

F. G. DONNAN.

ECONOMIC GEOLOGY.[1]

THE exploitation of the mineral resources of this country, previous to the war, was, apart from the ordinary fluctuations due to variations in supply and demand, governed almost entirely by the cost of production as compared with that of importation. Materials required for the manufacture of many articles, in some cases even munitions of war, were bought in the cheapest market, with the result that certain minerals ceased to be worked, not because the supply was exhausted, but because they could not be produced at a profit; whilst others which had recently acquired an economic importance were not even diligently searched for.

With the outbreak of war the inconvenience of this policy became painfully manifest, and it is not surprising to learn, from the Director's preface to the first of these "special reports," that numerous inquiries were made at the Geological Survey Office as to the occurrence in Britain of various materials for the supply of which dependence had

[1] Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. i., Tungsten and Manganese Ores. Pp. iv+50. Price 1s. Vol. ii., Barytes and Witherite. Pp. iv+93. Price 1s. 6d. Vol. iii., Gypsum and Anhydrite; Celestine and Strontianite. Pp. iv+57. Price 1s. (London: H.M.S.O.; E. Stanford, Ltd.

been placed on imports. To meet the situation it was, therefore, determined to issue, as rapidly as possible, a series of memoirs on special subjects. For this purpose the Geological Survey was well equipped. In the course of their normal work, that of surveying the country first on the one-inch and then on the six-inch scale, they had acquired and recorded in the maps and memoirs relating to special districts a large amount of information as to the mineral resources of the country. But this information, except in the case of a few substances, such as oil-shales and china-clays, was not readily available to those interested in particular minerals. The preparation of these memoirs, therefore, consisted in collecting the information which is scattered through the various local publications extending over a period of sixty or seventy years, and in supplementing this, so far as time would permit, by special investigations in districts where the minerals in question occur.

Three memoirs have now been published. The first deals with ores of tungsten and manganese, the second with barytes and witherite, and the third with gypsum and anhydrite, celestine and strontianite. The same general plan is followed in each case. The introductory chapters deal briefly with the composition, properties, and uses of the substance, with the rise and progress of the industry in this country, and with statistics of production. Then follows the most valuable part from the practical point of view, namely, that which deals with the mines or quarries from which the minerals are or have been produced, and also with occurrences which have not yet been commercially exploited. Take as an illustration of the method of treatment the case of tungsten. Its principal ore, wolfram, usually occurs in association with cassiterite, from which it is not easily separated. Previous to the discovery, in comparatively recent times, of the use of the metal in the manufacture of high-speed steel and filaments for electric lamps, wolfram was regarded as a nuisance by tin-miners. It was thrown away on the dumps, and caused the abandonment of several Cornish mines, some of which have been reopened in recent years in consequence of improved methods of dressing the mixed ore and of the value of what was formerly a waste product.

In the special part of this memoir the mines, whether abandoned or working, in which ores of tungsten occur are individually described. In the case of each mine the locality is indicated, not only by name, but also by reference to the one-inch and six-inch maps and to latitude and longitude. When the name only of an old mine is given it is often extremely difficult to fix its precise locality, but by this method all difficulty is removed. In the case of abandoned mines the old records have been examined, and all available information is given as to the course of the lodes, their content in wolfram and other minerals, and their relation to the surrounding rocks. In the case of mines now being worked the information on these points has been brought up to date, and is, of course, much more complete. The position of each mine in relation to roads and railways is given, and, when information is available, its condition as regards water. From the above statement it will be seen that the requirements of the practical man have been supplied so far as possible.

The three memoirs already published have been produced by the existing staff of the Geological Survey, notwithstanding the fact that several of its members are serving with the Army in various capacities. In view of the urgency and importance of this kind of work, some of which has direct reference to the war, we venture to ask whether it would not be advisable to increase the output by utilising the services of unofficial geologists?

We congratulate the Director and his staff on the excellence of these memoirs, and on the rapidity with which they have been brought out; and we hope that it will not be long before they are followed by others of a similar character.

COLONEL SIR CHARLES WATSON, C.B., K.C.M.G., R.E.

WE regret to record the death of Colonel Sir Charles Watson, in London on March 15, at the age of seventy-one.

Sir Charles Watson was the son of William Watson, a well-known civil engineer of Dublin, and he distinguished himself in mathematics and modern languages at Trinity College. In 1863 he entered the Royal Military Academy, Woolwich, at the head of the list, and two years later was commissioned in the Royal Engineers. Interested in the scientific side of his profession, Watson took up submarine mining, which was then a new branch of military engineering, and was posted to the first submarine mining company in 1871. About this time, also, he interested himself in ballooning, though not until later was this branch of military science actively developed.

While at Chatham he came under the notice of General Gordon, who invited him and Lieut. Chippendale, R.E., to accompany him to the Sudan. They travelled with General Gordon to Khartoum and thence up the Nile to Gondokoro. Watson carried out such a survey of the White Nile and the Bahr el Tebel as was possible from the steamer, and his work was a great advance on the earlier maps of the river. From 1874 up to 1900 his work was the basis of all maps of this part of the Nile's course, and when the opportunity arose for a new survey of the Bahr el Tebel, Watson's observations, made twenty-seven years before, were of great value in determining the permanence of the river channel and the alterations which had taken place in its branches. He also made careful meteorological observations in the marsh region, and measured a discharge of the Sobat River at its junction with the White Nile. Invalided to England in 1875 he was again in Egypt in 1882, but both then, and again later when in the Egyptian Army, military duties prevented him from devoting much of his time to scientific work.

After his retirement from the Army, in 1902, he organised the British Section of the St. Louis International Exhibition in 1904. His interest in Egypt and the Sudan never waned, and in 1912 the latter was the subject of an address which he gave as president of the Geography Section of the British Association. His interest in the East, and in the scientific study of it, led to his accepting the presidency of the Palestine Exploration Fund in succession to his friend and brother-officer, Sir Charles Wilson, and in this position he not only supported the prosecution of scientific archæology, but also advanced our knowledge of the topography of southern Palestine.

Interested in metrology, he championed, in a work on the subject, the cause of British weights and measures as preferable to those of the metric system. His inquiries into the various standards of length led him into an interesting bye-path of history, and it was only last week that we published a paper by him wherein he showed the close connection of our present standards of length and area with the old Egyptian and Babylonian measures.

NOTES.

On account of the restrictions imposed by the Government on the importation of wood-pulp and other materials used in paper manufacture, the supply of paper has been compulsorily reduced. In common with other periodicals, we are, therefore, under the necessity of reducing the size of NATURE; and we ask the indulgence of our readers for the cultailments which must be made while the limitations of paper-supply exist. It is particularly desirable that all contributors should confine themselves to essentials, points of prime importance, in order that our record of scientific work and events may still be as extensive as possible, though it must necessarily be less detailed. We trust that the present conditions are only temporary, and need scarcely say that immediately the normal supply of paper is available we shall revert to the usual number of columns.

THE *London Gazette* of March 13 notifies the appointment of 2nd Lieut. G. I. Taylor, R.F.C., to the temporary rank of Major in the Royal Flying Corps, while performing the duties of professor of meteorology. Major Taylor is a fellow of Trinity College, Cambridge, to whom the Adams prize was recently awarded. He is the author of the valuable report on meteorology in the voyage of the *Scotia*, undertaken for the Board of Trade. Up to the outbreak of war he held the Schuster readership of the Meteorological Office at the University of Cambridge. His predecessor in that appointment was Mr. E. Gold, now Commandant of the Meteorological Section, R.E., who was mentioned in Lord French's despatches, and has been nominated for the D.S.O. The professorship of meteorology to which Major Taylor is appointed is a new establishment, for which the Meteorological Office is responsible, for instruction and special researches in the structure of the atmosphere in the interest of the Royal Flying Corps.

WE regret to see the announcement of the death, on March 16, of Lady Kelvin: she survived by nine years her husband, who died on December 17, 1907. Lady Kelvin (*née* Frances Anna Blandy) was a daughter of the late Charles R. Blandy, one of the principal residents of Madeira. Lord Kelvin, then Sir William Thomson, first met her during one of the submarine cable-laying expeditions, in June, 1873. The acquaintance then made ripened into more than friendship, and a year later Sir William sailed to Madeira in his yacht, the *Lalla Rookh*, to claim Miss Blandy as his wife. They were married on June 24, 1874, and sailed back in the yacht. Early in August Lady Thomson was welcomed into the circle of family relations and university colleagues at Glasgow, and directed his household with dignity and grace. She became the inseparable companion of his after life, and accompanied him not only in his many summer voyages on his yacht, and on two trips to the United States, and on visits to foreign academies, but became a familiar figure at British Association meetings and other scientific gatherings. Soon after their marriage Sir William and Lady Thomson busied themselves over the building of his country house, "Netherhall," near Largs, in Ayrshire, the scene in after years of many family reunions and of extended hospitalities. It was to this house that Lord Kelvin withdrew when he retired in 1899 from his professorship at Glasgow; it was there that he died, and there also Lady Kelvin has died. Lady Kelvin from about twenty years ago had suffered from rheumatic troubles, and was accustomed to pay an annual visit to Aix-les-Bains for a course of treatment. It was during her return from that resort in September, 1907, that she was struck down by a severe paralysis, from which she had not recovered when Lord Kelvin died, and which left her infirm for the rest of her life, which she spent between the home at Netherhall and the residence in Eaton Place, Belgravia, which Lord Kelvin had taken after his elevation to the peerage in 1892. Lady Kelvin was fond of society, and played the part of hostess with stately dignity. She was president of the West of Scotland Women's Unionist Association, but otherwise took no considerable part in politics. The assiduous care and thought with which she devoted herself to Lord Kelvin during his declining years are known to all.

DR. D. H. SCOTT, F.R.S., has been elected a foreign member of the Royal Swedish Academy of Sciences, in succession to the late Count Solms-Laubach.

THE anniverary meeting of the Chemical Society will be held on Thursday, March 30, when Dr. Alexander Scott will deliver his presidential address, entitled "Our Seventy-fifth Anniversary."

THE Right Rev. Dr. J. H. Bernard, Archbishop of Dublin, has been elected president of the Royal Irish Academy in succession to Prof. J. P. Mahaffy, Provost of Trinity College, Dublin.

THE *Morning Post* of March 20 announces that Thursday last, being the seventieth birthday of the distinguished Swedish mathematician, Prof. M. G. Mittag-Leffler, he and his wife bequeathed their entire fortune to the foundation of a new International Institute for pure mathematics.

THE Secretary of the War Office announces that Surgeon-General W. Babtie, V.C., has been appointed to assist Surgeon-General Sir A. Keogh, Director-General Army Medical Services, especially in the work of supervision of invaliding and all questions connected with the physical fitness of the troops at home.

WE learn from the *American Journal of Science* that Prof. J. C. Moberg, of the University of Lund, Sweden, the distinguished palæontologist and stratigrapher, died on December 30, 1915, at the age of sixty-one years. His scientific work related in the main to the older Palæozoic formations of Sweden.

SIR THOMAS H. HOLLAND, F.R.S., professor of geology and mineralogy in the University of Manchester, has been appointed chairman of a Commission which the Government is forming to survey the economic resources and industrial possibilities of India, with the view of promoting business enterprise under the changed conditions that will follow the restoration of peace.

THE death of Sir Charles Ball, Bart., at sixty-five years of age, occurred on March 17 in Dublin. Sir Charles Ball was honorary surgeon to the King in Ireland, and regius professor of surgery in the University of Dublin, and the author of various works on surgery. The late Sir Robert Ball and Dr. Valentine Ball, director of the Dublin Science and Art Museum, were his elder brothers.

MISS GLADYS POTT, who recently visited France with a party of working women, under the auspices of the Board of Agriculture and the Board of Trade, will give an account of her experiences at a meeting, organised by the committee of the Women's Patriotic Bureau, 415 Oxford Street, to be held at the Kensington Town Hall on Friday, March 31. H.R.H. Princess Christian of Schleswig-Holstein has consented to be present; and the chair will be taken by the Lady Wantage. In view of the importance at the present time of training women in this country in farm work, and of interesting scientific agriculturists in the matter, it is hoped that the meeting will be largely attended by people disposed to assist the scheme.

THE twenty-fifth annual report of the council of the Institution of Mining and Metallurgy, presented at the annual meeting of the institution, held to-day, shows that in March, 1915, more than 300 members of the institution were serving with H.M. Forces. Since then the number has been more than doubled, and it now represents above 25 per cent. of the total membership. The membership of the institution on December 31 last was 2441, as compared with 2492 at the end of 1914. During 1915 thirty members of the institution lost their lives in the war. Sir Richard A. S. Redmayne has been elected president, in succession to Sir Thomas K. Rose.

ELIZABETH LADY LAWRENCE, whose death on March 18 we record with regret, only survived her husband, the late Sir J. J. Trevor Lawrence, by a little more than two years. She shared her husband's love of plants and beautiful flowers; and at their country seat at Burford, Dorking, was to be seen one of the finest private collections of conspicuous sorts, as well as many of the most interesting genera and species of both hemispheres. Lady Lawrence continued the long and honoured association of Sir Trevor Lawrence with the Royal Horticultural Society, and recently took an active part in the work of the fund organised by the society for the relief of ruined Belgian horticulturists. She was also keenly interested in astronomy, and had a wide circle of scientific friends, all of whom will long mourn her death.

WITH the approval of the King, Royal medals of the Royal Geographical Society have been awarded as follows:—The Founder's Medal to Lieutenant-Colonel P. H. Fawcett, for his explorations and surveys on the upper waters of the Amazon; and the Patron's Medal to Capt. F. M. Bailey, Indian Army, for his exploration of the Tsangpo-Dihang river in the hitherto almost unexplored country where it breaks through the Himalayas. Other awards adjudged by the council of the society are:—Murchison award to Lieut.-Colonel Whitlock, R.E., for his work in connection with the delimitation of the Yola-Chad boundary in 1903–5, and the Yola Cross river boundary in 1907–9; the Back award to Mr. Frank Wild, second in command of Sir Ernest Shackleton's transcontinental Antarctic Expedition, for his distinguished and long-continued services in the exploration of Australia; the Cuthbert Peek award to Mr. F. Kingdon Ward for his several enterprising journeys in the frontier regions between China and Burma, and to assist him in the further exploration of those regions; the Gill Memorial to Lieut.-Colonel E. M. Jack, R.E., for his distinguished service in the delimitation and demarcation of the Uganda-Congo boundary.

THE American *Museum Journal* for January, which has just reached us, contains a very interesting article by Messrs. Clark Wissler and Herbert Spinden, on the Pawnee human sacrifice to the morning star. According to the authors, the "historic home of the Pawnee was Nebraska." As a matter of fact, the Pawnee belonged to the very considerable Shoshone-Pawnee family, whose range was much wider. But, be this as it may, the authors have brought together some extremely useful facts in regard to the occasional sacrifice by these people of a young girl, always a prisoner of war. This was a religious observance, and the captive was treated as a goddess, till the day of the sacrifice. The custom seems to have come from Mexico, where prisoners of war were similarly treated, but in this case the victims were males. The authors give a very complete account of what is known of these ceremonies, and to this they add a number of most excellent illustrations.

THE *Museums Journal* for March very properly reprints the recent discussion in the House of Lords on the closing of museums, thereby affording those who are concerned with the conduct of such institutions a convenient source of reference to this epoch-marking event. For we have in this the measure of the value our rulers set upon the scientific work of the country. We talk much of the education of the "masses," but it is now abundantly evident that the "educated" have still much to learn. Many of the speakers during that debate seemed to be under the impression that the mental equipment attained at Eton suffices to meet all the demands of later life. Though some of the speakers were actually trustees of the British Museum, yet they displayed neither knowledge of the nature of the work of that institution, nor of museums in general.

THE flora of the Maltese Islands was first studied in 1827–31 by Prof. Stefano Tesaga, and in his "Floræ Melitensis Thesaurus" he enumerated 635 species of Phanerogams, 489 of which were natives of the islands. Then followed Delicata's "Flora Melitensis," with an enumeration of 726 species of flowering plants, and this formed the most complete account of the Maltese flora up to the present time. It is true that further additions to the flora have been made from time to time since then, noticeably by Dr. A. C. Gatto, Mr. J. F. Duthie, E. Armitage, and Col. M. J. Godfrey. Finally, Dr. Sommier, the well-known Florentine botanist, explored the flora in 1906 and 1907, and at that time arranged with Dr. A. C. Gatto to write a new flora of Malta, which was published in Italian at Florence at the close of last year, under the title of "Flora Melitensis Nova." We are indebted to Mr. G. Gambin, of Malta, for bringing this work to our notice, and also for an interesting review by Dr. J. Borg which appeared recently in the *Daily Malta Chronicle*. The new flora consists of 500 pages, and includes 916 species of Phanerogams and vascular Cryptogams, 78 Mosses, 18 Hepatics, 183 Lichens, 296 Algæ, and 499 Fungi. The flora on the whole is closely related to the Sicilian, though many plants are also found in North Africa. There are also a few interesting endemic species.

THE third part of "The Useful Plants of Nigeria," forming Additional Series No. ix. of the Kew Bulletin, has just been published. This part, consisting of pp. 343–536, includes the families Rubiaceæ to Labiatæ inclusive, and deals in detail with the plants of economic value contained in those families. The publication is a valuable companion volume to the "Flora of Tropical Africa," also emanating from Kew, and stands to the flora in a similar position as does Sir George Watt's classic "Dictionary of the Economic Products of India" to the "Flora of British India." Now that the "Flora of Tropical Africa" is nearing completion, it is to be hoped that the publication of the final part of this useful complementary volume dealing with the economic plants will not be long delayed. One of the most valuable features in "The Useful Plants of Nigeria" is the list of references cited at the end of each species, which appears to be well-nigh exhaustive in every case. The present part contains accounts of various rubber-yielding plants, tobacco, coffee, teak, *Achras Sapota*—the source of chicle gum—etc. With regard to this latter product, as, indeed, is the case with many other plants of economic importance, botanists are not yet certain as to the exact species or variety of tree which yields the commercial article. This publication is not only of value for our West African colonies, but is of great use at home as a source of information about the economic possibilities of tropical Africa.

P. PORSILD describes in *Meddelelser om Grönland*, vol. li., p. 253, the measures that have been taken to establish nature-reserves for plants in western Greenland, and he quotes a notice-board written in the Eskimo language, which is in itself good evidence of the spread of civilising influences.

IN *Physis* (the journal of the Sociedad Argentina de Ciencias Naturales) for November 10, 1915, F. Pastore describes some of the basalts that cover an enormous area in the plateau-land of Patagonia. At the base of the flows, which appear to have possessed great fluidity, tube-like vesicles have sometimes arisen, parallel to one another and several centimetres in length. This is clearly the same structure as that which gave rise to the "pipe-amygdaloids" of the British Isles In the same number, in reference to a notice that appeared in NATURE of April 22, 1915, it is pointed out that R. S. Lull decided against the proboscidean nature of Pyrotherium before fully considering the characters of a skull described by Loomis. C. Ameghino afterwards urged the importance of the cranial features, and *Physis* hopes that Prof. W. B. Scott will now state his opinion of them.

PROF. H. F. OSBORN has contributed to a new part of the Annals of the New York Academy of Sciences (vol. xxvi., pp. 215–315) an exhaustive review of the Pleistocene formations of Europe, Asia, and northern Africa, with full references to the recent literature of the subject. It is written in the same style as his well-known volume on "The Age of Mammals," and may be regarded as a revision and extension of the Pleistocene chapter of that work, with the addition of new discoveries. A glance at this review makes it possible to realise how difficult is the interpretation of the local superficial deposits on which alone our knowledge of the latest period of geological time is based. It is scarcely surprising that geologists' views on the Pleistocene glaciation of the northern hemisphere are very varied.

THE use of submerged wire drags towed by two ships at a short distance from one another has considerable value in increasing the accuracy of large-scale charts. Experience has shown, again and again, that even in the most carefully sounded seas dangerous rocks may be missed and only found by a ship striking. The work is, of course, neither necessary nor applicable in deep waters, but from 1906 onward a large amount of submarine survey has been accomplished by wire drags on the coast of New England. The value of the method and the cost entailed are discussed in a paper published by the U.S. Coast and Geodetic Survey (Special Publication No. 29). Several diagrams show the apparatus and methods, but these were described in detail in an earlier publication (No. 21). In order to ensure that the bottom wire is at the right depth to catch all obstructions, it is not allowed to swing free in a single sweep from one vessel to the other, but is suspended from a line of buoys. And, furthermore, to obviate the necessity of the buoys being very close to one another, and yet to prevent the line sagging, cedar floats are attached to the line between the buoys. These serve to balance the weight of the line. The nature of the method only admits of its being used where the general contours of the sea bottom have already been determined by sounding. It appears that on the coast of New England the wire drag has disclosed many unsuspected rocks and reefs.

WE have received from the director of the Royal Meteorological Institute of the Netherlands a set of copies of the De Bilt declination, horizontal force, and vertical force curves on the principal days of magnetic disturbance of the year 1913. The preparation and circulation of such curves is an international scheme, De Bilt serving as headquarters for the selection of the days. On the whole, 1913 was a very quiet year magnetically, and none of the selected disturbances were very large. They include, however, several interesting movements, amongst others three "sudden commencements." The curves are clearly shown on good paper, and full details are given of scale values and base-line values.

MESSRS. A. GALLENKAMP AND CO., LTD., announce the issue of a set of models and other apparatus designed with the view of facilitating the teaching of military science. Four of these, bearing on field telephones, are now ready, and should prove of service to teachers in the various schools and colleges in which military instruction is in progress. The items consist of a diagram-model of the D Mark III. telephone, arranged so as to show the working and adjustment of the buzzer, models of the receiver and transmitter, both of which may be dissected, and a board showing the correct method of repairing a broken line in the field. The tracing of circuits and the arrangement of windings is made easy by the use of coloured cords, and an examination of the models should enable a beginner to form a correct idea of the working of the various parts. Models of this kind should be found specially useful at military training centres, as a telephonist who understands his instrument is far more trustworthy than one whose work is merely automatic. Full descriptions of the models are contained in the circular issued by the firm.

La Nature for February 26 contains an illustrated description of the Nice automatic public telephone system, which has been in operation since October, 1913, and has now 3000 subscribers. The subscriber wanted is called up by the sender of the message without the intervention of any person at a central office. This is done by means of a small circular disc with numbered holes round its circumference attached to the front of the ordinary telephone box. The sender who wishes to ring up, say, No. 2547, on taking down his receiver is automatically connected to a selector at the central office. On inserting his finger

in the hole numbered 2 of his disc, and rotating it to the stop at zero, two short currents are sent out, which move the arm of the selector to the second group of a thousand subscribers. A repetition of the rotation with the finger in the hole 5 moves the arm of a second selector on to the fifth hundred, and so on until the actual subscriber wanted is reached. When the receiver is hung up the sender's connection with the selectors is broken. The arrangements of the circuits of the selectors are shown by figures, and the author, M. E. Coustet, considers an automatic system of this kind the only solution of the present difficulty of apportioning the blame for delays between the subscriber and the *personelle* of the exchange.

IN the *Scientific American* of February 12 there is an account of an invention by Mr. J. B. Flowers of a new phonetic machine. The complete apparatus is still at an experimental stage, but much has been accomplished. Mr. Flowers has investigated the physical nature of whispered sounds lasting for short periods, say, the 1/50th of a second; and as a recorder he makes use of Einthoven's string galvanometer, acted on by an acoustical transmitter. The oscillations of the galvanometer were all photographically recorded on a revolving drum, and it is found that there is a definite form for each whispered sound. Thus there is always the same picture, say, for the sound B, and the number of times this picture is repeated in, say, 1/50th of a sec.—*frequency*—determines pitch, while *amplitude* of the components of the picture determines *intensity*. Thousands of experiments have been made, and thus Mr. Flowers has constructed a new phonetic alphabet, each letter of which has always the same form or curve. The next step was the invention of another instrument which would record the speech patterns, not as sounds, but as variations in intensity. This is accomplished with the aid of sensitive electrical resonators, varying in pitch; these act on a beam of light which vibrates on a selenium cell, and the sound patterns are reproduced by varying resistances acting on an electrically-driven pencil and drum. Speech sounds may also be directly recorded in this way, without the use of the string galvanometer. It is this part of the apparatus that appears to be incomplete, but it is said that the record so obtained "is fully as easy to decipher as that of a siphon recorder used in cable telegraphy."

PROF. O. D. CHWOLSON, in a paper, "Sur les poids atomiques," in the *Bulletin de l'Académie Impériale des Sciences* (Petrograd), discusses the numerical values of the atomic weights from the point of view of the part played by the number 4, that of the helium atom, which radio-active change has shown to be an integral part of the atoms of the radio-active elements. He shows that the number of elements approaching the value $4n$ is one and a half times greater than those approaching the value $4n+2$, where n is an integer, and that whereas the first class tend to approach the whole number, the second class tend to avoid it. Considering the departure of the atomic weights from whole numbers of the form $4n$ he discovers a preference for the values comprised within 0 and ± 0.5, and between ± 1 and ± 1.5, which may be attributable to the presence of an atom of hydrogen.

IN connection with the University of Calcutta, "extension lectures" are being delivered, and that on January 10, by Dr. P. C. Rây, the dean of the faculty of science of the University, is before us. The lecture consists of a brief *résumé* of original chemical researches carried out in Bengal in the last twenty years, and as an appendix a list of 126 papers contributed to various societies, such as the Chemical Society, Journal of the American Chemical Society, and others, is given. Some of these papers are of very considerable value and interest, and indicate enthusiastic work on the part of this newly created school, which is mainly due to the example and work of Prof. Rây himself. Prof. Rây's first published work was the "History of Hindu Chemistry," written about thirteen years ago, in which he showed there was considerable scientific spirit and also more or less empirical work amongst the ancient Hindus, as indicated in their religious writings, "Tantras," etc., written in ancient Sanskrit. It is, of course, only a man like Prof. Rây, well acquainted with Sanskrit and with a thorough knowledge of modern chemistry, who could have written such a work. In this book Prof. Rây deplored the decline of scientific spirit in India, and "lamented that the spirit of inquiry had died out amongst a nation naturally prone to speculation and metaphysical studies." He now writes:—"Little did I dream that in the course of a decade or so I should have to revise the estimate I then formed of the capacities of my own countrymen and chronicle that a bright chapter is about to dawn in our life-history." It certainly appears from the present activity of original chemical research in Bengal that a new spirit is abroad, and it is to be hoped that this will quickly spread over the remainder of India, and that the same spirit of research will embrace all the other sciences.

THE *Amateur Photographer and Photographic News* have just issued their seventh annual "Empire Number," an enlarged number that appeals especially to the Colonies and Overseas Dominions and those in this country who seek a more intimate relationship with them. It is well illustrated, and includes contributions, both pictorial and literary, from Africa, Australia, India, and other parts of the British Empire.

A NEW and revised edition of Yarrell, Newton, and Saunders's "History of British Birds," edited by W. Eagle Clarke, is in course of preparation for publication by Messrs. Gurney and Jackson. The late Mr. Howard Saunders placed all his collected notes for a new edition of the work at Mr. Eagle Clarke's disposal. A feature of the new edition will be a coloured plate of each species, the work of Miss L. Medland.

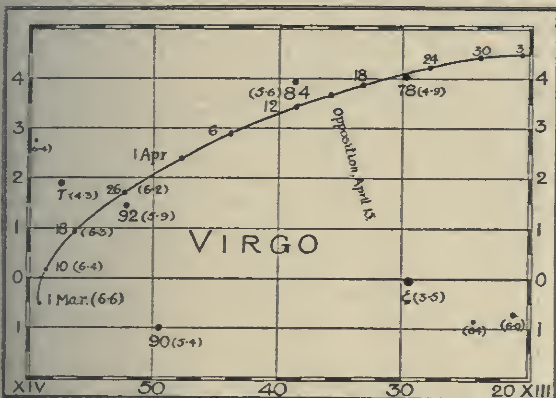
THE following volumes are in preparation for Messrs. Longmans and Co.'s "Text-books of Physical Chemistry"—Electro-Chemistry, part ii., Dr. E. B. R. Prideaux; Practical Spectrographic Analysis, Dr. J. H. Pollok; Crystallography, T. V. Barker. For appearance in the same firm's "Monographs on Inorganic and Physical Chemistry" the following are in preparation:—Electrolytic Dissociation Theory, Dr. J. C. Philip; The Physical Chemistry of Flames, J. E. Coates; Clays, Dr. J. W. Mellor; Catalysis of Gas Reactions, D. L. Chapman; The Electro-Chemistry of Non-Aqueous Solutions, J. W. McBain; Catalysis in Liquid Systems, Dr. G. Senter; The Rare Earth Metals, Dr. J. F. Spencer; Hydrates in Solution, Prof. E. A. Washburn; Adsorption, V. Lefebure and A. M. Williams.

OUR ASTRONOMICAL COLUMN.

OPPOSITION OF THE MINOR PLANET (4) VESTA.—G. Stracke has calculated an ephemeris for this planetoid for the period including the coming opposition on April 15 (Circular No. 502, *Astronomische Nachrichten*). Vesta is the only one of the very numerous swarm of lesser planets that at times becomes visible to the unaided eye, and although this opposition is not the most favourable possible, yet it occurs towards peri-

helion, and the apparent stellar magnitude will be 6·2. It will be upwards of four years before a better conditioned opposition takes place. The accompanying chart shows its apparent path. After about March 26 its magnitude does not appreciably alter during the period shown on the chart. The positions of the four stars nearest to the path are corrected for precession. The

PATH OF THE MINOR PLANET VESTA.



positions and magnitudes of the stars shown are otherwise taken from the catalogue of naked-eye stars prepared by Mr. T. W. Backhouse. Attention is especially directed to the very close appulse of the planet and the star Flamsteed 78, approximately during the early morning of April 22.

SPECTROSCOPIC OBSERVATIONS OF COMETS 1913*f* (DELAVAN) AND 1914*b* (ZLATINSKY).—N. v. Konkoly has published results of visual spectroscopic observations of these comets made during 1914 (*Astronomische Nachrichten*, No. 4833). The spectra of both were particularly bright, and presented a striking similarity. The sodium D line was seen in the spectrum of Delavan's comet. The mean of a large number of settings on the "bright yellow pearl," as it appeared on September 30, gave λ 589·6. Five hydrocarbon bands were measured in both, the wave-lengths for Delavan's comet on October 17 being 559·54, 543·50, 516·63, 488·38, and 472·38. In Zlatinsky's comet the band at λ 516 was the brightest, the relative intensities, from the red, being 0·5, 0·2, 1·0, 0·4, and 0·3.

AN ATMOSPHERIC EFFECT OF SOLAR KATHODE RAYS.—Reference was made in this column on October 28 to M. J. Maurer's observation of a new atmospheric optical effect synchronising with rapidly increasing solar activity. M. J. Maurer made a more extensive contribution to the *Meteorologische Zeitschrift* on the same subject, and attention is now directed to an English translation of this appearing in the U.S. *Monthly Weather Review* (vol. xliii., No. 11).

MR. IVAN LEVINSTEIN.

THE death, in his seventy-first year, of Mr. Ivan Levinstein, which occurred on March 15, at his residence at Hale, near Manchester, removes a conspicuous figure from the world of industrial chemistry. He went to Manchester about the year 1864 from Berlin, where he had studied chemistry at the Technical High School, and established himself in business in Blackley, in the heart of the dyeing industry of south-east Lancashire, as a manufacturer of aniline dyes, being himself not only his own actual producer, but his own salesman also. He quickly laid the foundations of a flourishing business, and soon began to identify himself conspicuously with the industry and commerce of the city, associating himself also with the active direction of other chemical enterprises like those of the Ammonia Soda Company of Plumbley, and Murgatroyd's Salt Company, of Middlewich. He was the active promoter of the fine chemical exhibit which attracted so much attention at the Manchester Jubilee Exhibition of 1887. He was also the founder and for some time the editor of the *Chemical Review*, one of the first technical journals established in this country. He was twice president of the Society of Chemical Industry, and vice-president of the Society of Dyers and Colourists and of the Manchester Chemical Club. He was for many years a director of the Chamber of Commerce and a past-president, and he was closely identified, for more than thirty years, with the development of the Manchester School of Technology, which owed much to his keen intelligence and sound knowledge of technical matters. The Manchester University, of the Court of which he was a member, awarded him the degree of M.Sc. in recognition of his many services to technical science. His name will always be remembered for his stout advocacy for the reform of the Patent Laws, which gave so unfair an advantage to the foreigner, and he undertook at great personal risk many successful actions against certain of the great German chemical firms in order to compel them to grant licences to manufacturers to work their patents in this country. As he once said, "they had patented the whole field of organic chemistry by their astute method of drafting their patents." His unwearied agitation resulted in the Act of 1907, of which he may truly be said, after efforts which had extended over twenty years, to be the real author.

METHODS AND APPLIANCES FOR THE ATTAINMENT OF HIGH TEMPERATURES IN THE LABORATORY.

WHAT was described as an informal discussion on the above subject was opened by Dr. J. A. Harker, F.R.S., on March 15 at a meeting of the Faraday Society. The meeting, which was presided over by Sir Robert Hadfield, F.R.S., attracted considerable interest, and many well-known experimenters in high-temperature work gave their experiences in the course of the discussion.

Dr. Harker, in the first place, described a recent type of carbon tube furnace at present in use at the National Physical Laboratory for standardising optical pyrometers. It is gratifying to know that the high-resistance, thin-walled carbon tubes employed are now made in this country. For many purposes graphite can be substituted for carbon. This material has the advantage of being easy to tool, but in order to increase its resistance, a spiral or zigzag groove has to be cut along the tubes, and the simple device of wrapping filter paper round the tubes prevents—when nothing but ash remains of the paper—the heat-insulating material from falling through the grooves. For this insulating material Dr. Harker recommends that highly flocculent soot known as paint-maker's lamp-black. Finally, the furnace must be completely closed in by a framework of wire-netting coated with cement to form a kind of solid ferro-concrete block. This is necessary on account of the carbon monoxide that is produced, as well as for thermal reasons. Copper bands wrapped round the ends of the tubes as terminals practically complete the furnace, but water-cooling is necessary to prevent undue heating at the contacts to keep down the voltage; indeed, attention to the terminal contacts is a necessary condition of smooth running, and inattention to this is a frequent source

of avoidable trouble in electric furnace work. The furnace shown in operation at the meeting consumed 100 amperes at 10 volts when running at 2000° C. This temperature was attainable in two or three minutes. A home-made transformer with about 100 primary turns wound in two halves and three separate secondary coils that can be connected in series or parallel enables the furnace to be run off almost any ordinary lighting circuit.

Mr. R. S. Whipple, among other speakers, testified to the value and convenience of this simple form of carbon tube furnace. It was stated that Northrup in America was using a similar furnace on a larger scale for gear hardening in a motor-car factory. A thermocouple is attached to each piece of gear and the temperature is run up until the hump on the curve shows the recalescent point to have passed. The gear is then removed and quenched. One of the furnaces exhibited by Dr. Harker was made for a steel foundry at Sheffield for standardising optical pyrometers, of which a very large number were stated to be in use.

The discussion emphasised the fact that the great desideratum at the present moment for many requirements, both in the laboratory and the works, is a furnace that will have all the advantages of the carbon tube furnace, but which will not evolve carbon compounds. Dr. Rosenhain had used a vacuum furnace wound with tungsten wire for melting pure iron (melting point $1525 \pm 5°$ C.), but the tungsten became brittle after heating, and was soon useless. A resistance furnace using granular tungsten working in hydrogen or nitrogen was suggested as one substitute, and another was a carbon tube furnace with an inner tube and an indifferent gas between the two. It appears, however, that zirconia tubes are being experimented with, and a successful outcome of this work is hopefully anticipated. Zirconia is one of the best refractories known, and if it can be obtained pure in granular form almost any temperature will be possible with surface combustion. Dr. Rosenhain made the useful suggestion to coat carbon electrodes or tubes—even in ordinary commercial electric furnaces—with metallic copper, iron, or aluminium by means of the Schoop spray process, as a means of ensuring good electrical contacts.

For temperatures up to 1000 or 1200° C., tube or muffle furnaces heated with nickel-chromium wire were recommended by several speakers, some of whom have abandoned gas-heating altogether for temperatures below 1000°. On the other hand, some of the modern gas burners, of which several types were described, appear to give excellent results at high temperatures. Air under high pressure is essential, and so it appears is violent mixing of the air and gas—the cause of the great noise made by these furnaces. Mr. S. N. Brayshaw described the ingenious burner which bears his name, which is displacing the oxy-hydrogen flame, too local in its heating, for melting platinum. For many experimental metallurgical purposes the Richmond gas furnace was recommended.

INSECTS IN AFRICA AND THE EAST.

An accurate description of the Indian lac insect (*Tachardia lacca*), founded on new observations of its life-history and habits, has long been wanted by students of economic entomology. They now find this provided in the recently issued Indian Forest Memoir (Zoology, vol. iii., part 1) by Dr. A. D. Imms and Mr. N. C. Chatterjee. The various stages are illustrated by beautifully executed coloured figures, and there are enumerations of the insect's food-plants and analyses of its important secretion. A remarkable feature is the dimorphism shown in the male, which may be either winged or wingless—the latter condition very rare among Coccidæ. The Tachardia is attacked by an alarming array of enemies, of which the caterpillar of a noctuid moth, *Eublemma amabilis*, is the most formidable. It is aided in its destructive efforts by several other caterpillars of Lepidoptera, a large number of beetles and their larvæ, and a host of hymenopterous parasites.

To the December part (3) of the Bulletin of Entomological Research (vol. vi.) Dr. J. W. Scott Macfie contributes observations on the bionomics of *Stegomyia fasciata*, the mosquito that is well known as the alternate host with man of the yellow fever parasite. The female insect pairs soon after emergence, and then must have a meal of blood before laying her eggs. Fertile eggs may continue to be laid for thirty-seven days without necessity for a second pairing. The prevalent belief that this mosquito sucks blood by night only is not confirmed, "but sometimes she refuses an offer to feed in daylight in favour of the next opportunity to feed in the dark." The male's taste is gentler, as his staple food is honey.

The same part of the Bulletin contains also notes, by Dr. W. A. Lamborn, on the habits of *Glossina morsitans*—the tsetse-fly that carries sleeping-sickness trypanosomes in Nyasaland. The insects are by no means confined to the mapped "fly-belts." The preponderance in number of males among flies captured on the wing, which contrasts with the close equality of the sexes as bred from puparia, is explained by the author as due to the male's habit of pairing as the result of violent capture rather than of courtship; hence the females shun the society of the opposite sex. The slimy secretion of the Glossina larva is believed by Dr. Lamborn to afford some protection against the attacks of certain ants. Puparia are rarely found parasitised by larvæ of Mutilla and other Hymenoptera, and the adult tsetses are sometimes caught and devoured by dragonflies. Dr. Lamborn described how a dragonfly, *Orthetrum chrysostigma*, hovered around his party of six "boys," swooping down and picking off a tsetse from the back of one who stooped to drink at a pool. Many specimens of the Orthetrum were captured in the act of devouring tsetses, which appear to be equally acceptable, whether fasting or filled with freshly-ingested blood, and this species of dragonfly is evidently very expert in catching Glossina. Another kind of dragonfly (*Crocothemis erythraea*), on the other hand, handled a tsetse so clumsily as to convince Dr. Lamborn that it is a novice with this special type of prey. A description with figures of several species of chalcids which Dr. Lamborn has reared from the Glossina puparia is given by Mr. J. Waterston (*t.c.* part 4).

An addition to our knowledge of the distribution of tsetses is contained in Dr. Schweiz's paper in the third part of the bulletin; he has traced *G. morsitans* in the Katanga district of the Belgian Congo far to the west of the great river. Dr. Schwetz writes also on the range and habits of *G. brevipalpis*—a fly often overlooked as it flies before sunrise and after sunset.

G. H. C.

INTERESTING FORAMINIFERA.

In a fine memoir[1] on Foraminifera from the Kerimba Archipelago, Portuguese East Africa, Messrs. Edward Heron-Allen and Arthur Earland deal with no fewer than 470 species and varieties, of which thirty-two are new to science. There is a striking resemblance between the general facies of the gatherings at Kerimba and that of the late Mr. F. W. Millett's collection from the Malay Archipelago. The

[1] Trans. Zoological Society of London xx (1914), pp. 363–90, 3 pls.; and *Ibid.*, xx. (1915), pp. 543–794, 14 pls., 3 figs. *See also* Proc. Zoological Society of London, 1915, pp. 295–8.

eading zoological feature is perhaps the great abundance of Miliolidæ, of which 122 species are reported, eventy-seven in the single genus Miliolina.

The authors have been fortunate enough to discover ome very interesting new types. Thus there is Iridia ith a diaphanous chitinous envelope covered over ith very fine particles of mud and sand. It seems o be an Astrorhizid, is usually attached to sandrains or shell-fragments, and may attain to the igantic size of 8 mm. in diameter. Strange, probbly abnormal, forms occur with a clear area on each ide of the shell, perhaps indicative of liberation from etween two large sand-grains. Similar, possibly dentical, forms have been described by Rhumbler rom a depth of 400 metres in the Antarctic, and amed *Vanhoeffenella gaussii*, the "windows" being nterpreted as adaptations to the very scanty rays of ght. But this would not apply to the fierce glare of he Kerimba shore. Another remarkable new type is Nouria, with several species, some of which show ery effective treatment of the material selected for hell-making. Thus in *Nouria harrisii* the test is ntirely composed of sponge spicules arranged in a ingle layer with their axes more or less parallel to he long axis of the test, but so as to form a perfectly apered neck and a regular fringe projecting around he mouth. There are sometimes spicules projecting borally, which may serve to keep the animal erect in he surface layer of mud.

Experts will be interested in what the authors have o say in regard to D'Orbigny's *Pavonina flabelliormis* and his *Rotalia dubia* (seen again after ninety ears!), in their revision of the lituiform species of Peneroplis, and in their very successful study of the ouble shells of Discorbina (apparently due to a kind of budding), and of the development of the peculiar lual nature of the terminal balloon-chamber which Earland noticed some years ago in *Cymbalopora bulloides*, D'Orbigny. But we shall rather refer to the emarkable discovery of specimens of *Cymbalopora abellaeformis*, occupying little pits in mollusc shells. Each Foraminifer seems to be able to enlarge its crypt is its test grows; nay, more, to excavate tunnels in he mollusc shell. These tunnels radiate round the crypt and may attain to a length many times its diameter. They are for the accommodation of the pseudopodia. It is interesting that the living matter which habitually secretes carbonate of lime should also dissolve it, and the possibility is suggested that the solution may be helped by carbon dioxide given off (at night?) by the symbiotic Algæ which are usually associated with this Foraminifer. The authors are to be congratulated on the use they have made of their fine material, in connection with which the skill and energy of Dr. J. J. Simpson, who made the collection, should be remembered.

SCIENTIFIC EDUCATION AND INDUSTRIAL RESEARCH.

SEVERAL professional bodies have devoted attention lately to education and science in relation to industrial development; and it is not too much to say that they all appreciate the need for action in order to prepare for the strain of competition which may be expected to follow the cessation of hostilities. On Tuesday, March 14, the subject was discussed at the Institute of Journalists by the Circle of Scientific, Technical, and Trade Journalists, under the title, "The Sphere of the Scientific and Technical Press in Relation to Technical Education and Research," Mr. L. Gaster, chairman of the circle, presiding. The discussion was opened by Dr. W. Garnett, late educational adviser to the London County Council, and by Mr. A. P. M. Fleming, who has recently made a tour of inspection of research laboratories in the United States. Dr. Garnett's main suggestions are as follows:—

(1) Education in elementary and secondary schools must be more directly associated with *things* so as to develop self-reliance and resourcefulness, not to teach trades.

(2) A considerable proportion of teachers should devote a third year of training largely to practical work under conditions enabling them to become acquainted with the practice of some trades.

(3) A general knowledge of the phenomena of nature and of processes applied in industry must be more widely diffused by means of popular lectures and otherwise.

(4) More completely organised courses of instruction, without breach of continuity, must be provided for industrial workers of all classes, including the leaders of industry, together with the necessary scholarships, fellowships, or bursaries to enable the best students to carry on post-graduate research.

(5) Existing institutions must be improved and some new institutions must be provided, especially in the chemical trades, to enable scientific discoveries to be developed sufficiently to demonstrate the conditions under which they can be made commercially successful.

(6) Some alterations must be made in the patent law to enable the profits arising from investigations conducted wholly or partly at the public expense to be fairly divided between the State, the scientific worker, and the manufacturer.

(7) Trades should be organised for the purpose of superintending the research work in which they are interested, for the collection and dissemination of information and the distribution of work among firms in the manner in which it can be most effectively and economically carried out in the interest of the industry as a whole.

(8) The trade associations should be in close touch with the Advisory Council for Research, and the council should, where necessary, recommend the award of Parliamentary grants in aid of industrial research carried out under the direction of the associations and make provision for such work in cases in which trade associations are not available, but the Advisory Council should utilise to the utmost the services of societies.

(9) As an alternative the Advisory Council for Research should appoint technical committees representative of trades, or groups of trades, to assist it in the organisation of industrial research.

(10) The National Physical Laboratory should be the central institution for all physical measurements and standardisation, but for chemical processes a separate institution for a trade or group of trades will frequently be required for the work intermediate between the discovery of a new product or reaction in the research laboratory and the adaptation of the process to commercial manufacture.

(11) Some method of financing new processes which have been approved by a competent authority, other than the ordinary method of floating a company, is desirable, and this may be provided by some form of industrial bank.

It will be noticed that, among other points, Dr. Garnett pleads not only for increased specialised courses of training in science and technology, but also for a knowledge of natural facts and phenomena as part of the education of all. When this has been secured, it may be hoped that "members of Parliament will cease to wonder whether we shall *ever* know why the moon appears to change her shape, and we shall not be told that lard has only just been discovered as a source of glycerine, that mineral oil from Galicia

is equally useful for this purpose, that wool will take the place of cotton in the manufacture of nitrocellulose for propellants, or that a cargo of phosphate has been seized lest it should be used by the enemy for the manufacture of phosgene gas."

Dr. Garnett suggested that, perhaps, in course of time, the Committee of the Privy Council concerned with the development of scientific and industrial research may, as in other cases, be replaced by a new Ministry; and that a National Chemical Laboratory might be established corresponding to the National Physical Laboratory, though the diversity of chemical trades and interests suggests that several co-ordinated laboratories would be required.

Mr. Fleming's account of the enormous amount of industrial research being carried on in the United States by individual firms, and the increased provision being made for research in universities and technical institutions, shows that America is fully alive to the commercial advantages of such work. He stated that in the United States at the present time there are upwards of fifty corporations having research laboratories, costing annually from 20,000*l.* to 100,000*l.* each for maintenance; and he added:—"Some of the most striking features of the research work in America are the lavish manner in which the laboratories have been planned and which in many cases enable large-scale manufacturing operations to be carried out in order to determine the best possible methods of manufacturing any commodity developed or discovered in the laboratory; the appreciation of men of higher scientific training by industry, resulting in increasing numbers of students proceeding to their doctor's degree before leaving the university; the increasing attention given in the research laboratories to pure science investigations, this being, in my opinion, the most important phase of industrial research; the absorption of men who have proven their capacity for industrial research in such places as the Mellon Institute, the Bureau of Standards, etc., by the various industries in which they have taken scientific interest."

While much work of prime importance has been done by individual investigators in this country, there is a general lack of appreciation by manufacturers of the advantages to be derived from the application of science to industry, and a tendency to avoid the employment of scientifically trained men. Steps have been taken by the Royal Society to organise scientific workers, and the Chemical Society has formed committees representing all branches of chemical science. Similar organisations of technical experts have been brought together by engineering societies. What seems to be particularly needed is a combination of the forces of education, science, manufacture, and commerce, instead of bodies in which these interests are separately represented. The only body in which this combination exists is the British Science Guild, which was founded in 1905, with the express object of bringing home to all classes "the necessity of applying scientific treatment to affairs of all kinds." The present European crisis affords an opportunity of unique importance for the guild to impress upon all who are engaged in the executive functions of Government, and especially upon those who are engaged in the sphere of industry and commerce, the paramount claims of science in its most advanced aspects of training and research.

The events of the present war have shown with striking clearness, not only the advantage which systematic education in science and thorough organisation of scientific research in its various applications have given, whether from a chemical or engineering point of view, to the chief of the Central Powers with which the Allies are engaged, but they have shown with no less emphasis the extent to which in the region of scientific industry Germany has grown to be the most formidable rival of the United Kingdom.

This result is not due to any merely adventitious circumstances, but is the direct fruit of the sedulous cultivation of science and of scientific research during the last sixty years, especially in the highest educational institutions of Germany; and it is the result also of the frank and liberal recognition by the great departments of the State and by the leaders of industry and commerce of its vital importance to the economic progress and well-being of the nation.

The recent important memorial, signed by men of high scientific and technical eminence engaged in the various departments of pure and applied science, directed the attention of the public to the grave character of the problems involved. It is now necessary to invoke the aid of the influential technical associations concerned with the development and advancement of the great scientific industries, of the chambers of commerce in the chief industrial and commercial centres, and of bodies representative of the workers engaged in the service of the more important industries. It is necessary also to engage the influence and support of bodies charged with the development of agriculture, in respect not only of improved scientific means and methods of cultivation, but also of the introduction into agriculture of other products of high value, with a view to render the nation less dependent upon foreign sources for its food supplies.

It is of prime importance that consideration should be given to the conditions upon which the *personnel* of the public service is recruited, particularly in respect of the choice of the higher officials. We may thus ensure a much closer sympathy with, and a keener appreciation of, the value of science and of its close relation to national progress, with the consequent careful and generous consideration of the curricula of the schools, so as to include a fuller measure of observation and experiment, and provide the means whereby the gifted of all classes can avail themselves of the highest facilities for education.

With the object of giving effect to these purposes and aims the British Science Guild is preparing a statement which will be submitted to leading representatives of many national interests, and the whole subject will afterwards be brought before the Government and the nation. The technical Press could perform a useful service by directing attention to the opportunity which the guild affords of uniting industry with education and science for their common good.

USE OF FOSSIL REMAINS OF THE HIGHER VERTEBRATES IN STRATIGRAPHICAL GEOLOGY.[1]

THE study of fossil fishes, referred to in the presidential address to the society in 1915, raised the question as to whether animals of apparently the same family, genus, or species might not originate more than once from separate series of ancestors. The higher vertebrates, which inhabited the land, may most profitably be examined to throw light on the subject; for the land has always been subdivided into well-defined areas, isolated by seas, mountains, and deserts, so that animals in these several areas must often have developed independently for long periods. Students of shells are unanimous in recognising what they term homœomorphy, and trace immature, mature, and senile stages in the course of every race that can be followed through successive geological formations.

[1] Abstract from the presidential address delivered to the Geological Society of London on February 18, by Dr. A. Smith Woodward, F.R.S.

vertebrate skeletons, which have much more numerous and tangible characters, and approach senility in more varied ways, should afford a clearer view of general principles.

Even among vertebrates the evidence that most concerns the geologist is not always easily interpreted. For instance, the Sparassodonta and horned tortoises of the Argentine Tertiary are so closely similar to the existing Thylacines and the fossil Miolania of Australia, that they are still sometimes quoted as proving the former existence of an Antarctic continent uniting the South American and Australian regions. On the other hand, they may be merely survivors of cosmopolitan races at the two extremes of their former range, with certain inevitable (but not altogether similar) marks of senility. In making comparisons, indeed, it is no longer enough to distinguish the fundamental and merely adaptive characters of animals; it is also essential to note separately those characters which depend on the early, mature, or senile position of the particular animals in the evolving series to which they belong.

Hitherto there seems to be only one case in which we have enough materials for forming a judgment as to whether a fundamental advance may occur more than once. Mammal-like reptiles are abundant in the Permian of North America and in the Permian and Trias of South Africa and other parts of the Old World. Recent studies have shown that all specialisations in the North American forms are in the direction of higher reptiles, while all those in the South African forms are in the direction of mammals. Hence, although there is evidence of two possible sources of mammals, only one appears to have produced them.

Among advances of lower degree, the origin of the monkeys or lower Anthropoidea may be considered. It is agreed that they arose from the Lemuroidea which were almost universally distributed over the great continents at the beginning of the Tertiary era. They seem to have evolved separately in America and in the Old World, but the two series are very sharply distinguished, although they form one zoological "suborder." When isolated on the island of Madagascar, some of these same animals acquired a few peculiarities of the American, others of the Old World Anthropoidea, but never really advanced beyond the Lemuroid stage, merely becoming senile just before their extinction. Hence, the Lemuroidea evolved in three different ways, and the resulting groups are very easily distinguished.

The study of the Tertiary Ungulata is especially important, because most of the groups arose either in North America or in the Old World, which were united and separated several times. It seems clear that, although each group probably originated but once in one particular area, its members soon diverged into several independently evolving series, each imbued with some definite impulse or momentum towards specialisation in the same way in the course of geological time, only at different rates. There were thus, for example, several distinct lines of horses and rhinoceroses, but all from the same source.

It is now well known that the characteristic South American Tertiary Ungulates arose in an isolated area, and many of their specialisations are curiously similar to some of those observed among European Eocene and Oligocene Ungulata which soon proved abortive or "inadaptive." They are, however, by no means identical.

While so many changes have occurred during the evolution of the vertebrates, the persistence of characters and the strength of heredity in numerous cases are still as perplexing as they were when Huxley first directed special attention to "persistent types."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. A. V. Hill, Humphrey Owen Jones lecturer in physical chemistry, and Mr. J. E. Davey have been elected fellows of King's College.

Mr. F. P. White, St. John's, has been elected to an Isaac Newton studentship for three years, and Mr. H. Jeffreys, St. John's, has been re-elected to a studentship for an additional year. The Allen scholarship for research in scientific subjects has been awarded to Mr. Franklin Kidd, St. John's.

LONDON.—Prof. H. Jackson, of King's College, succeeds Prof. A. W. Crossley as one of the representatives of the faculty of science on the Senate.

The report of the Military Education Committee for 1915 has been presented to the Senate. It states that the number of members of the University of London O.T.C. during the training year ended September 30 was 2209, of whom 1068 proceeded to commissions during that year. Up to the end of 1915, 2228 cadets or ex-cadets of the contingent had been granted commissions. Of these eighty-six had fallen in the war, and the honours and distinctions gained were one V.C., twenty-five military crosses, sixty-three mentions in despatches (four mentioned twice), and one Medaille Militaire. In addition, 273 commissions had been granted to graduates and students (other than cadets or ex-cadets), and these officers had gained four military crosses and ten mentions in despatches. Since the outbreak of war, eight monthly courses had been held in the officers' school of instruction in connection with the contingent, and more than 900 officers had passed through the school. Lists of officers who have fallen in the war and have gained distinctions are printed as appendices to the report.

OXFORD.—The Herbert Spencer lecture was delivered on March 15 by Prof. J. Mark Baldwin. Taking for his subject "The Super-State and the 'Eternal Values,'" Prof. Baldwin spoke of the distinction, on one hand, between instrumental and eternal or absolute values, and, on the other, between individual and super-individual values. Pointing out that these distinctions are not peculiarly German, he went on to show that with the advent of the present war it became evident that in the German conception the State is not a vehicle of simply individual or instrumental value. It is, according to the Germans, the expression of the full national will; it *is* value *per se*, summarising in itself the two super-individual values. The monarch symbolises this; no concession to the popular will is possible under such a conception, but the populace may be the recipient of free gifts from the State. Natural selection, or the survival of the fittest, is recognised, as, for example, in the victory of Turks over Arabs in the thirteenth century, or of Rome over Greece. Germany recognises two kinds of fitness—military efficiency and organisation. The spiritual and ethical weapon is wielded by the State alone. Military necessity knows no moral law; "might is right," *i.e.* super-individual might makes individual right. The observance of treaties is subordinate to the needs of the State; to be once a German is to be always of super-individual value; "Deutschland über Alles." So much for the German ideal. The opposed point of view makes itself felt in various domains, as in that of naturalisation, where the experience of the war has proved that documentary evidence is useless; in that of arbitration; and in that of cultural relations between peoples. In fine, Germany says that the nation is instrumental to the State; the democratic belligerents opposed to Germany hold that the State

has an instrumental value only, and that it is instrumental to the nation.

SHEFFIELD.—The council of the University has decided to institute a lectureship in Russian. It is understood that in view of the urgency of a knowledge of Russian in the trade of Sheffield, the necessary funds have been secured locally, and that an appointment to the lectureship will shortly be announced.

AMONG the bequests of Mr. J. S. N. Boyd, who died on February 1, leaving estate of the value of 32,646*l.*, are 2,100*l.* to Epsom College, for one foundation scholar, and the ultimate residue of the estate, after the death of his mother and sister, to the University of London for a professorship of pathology in the Medical School of Charing Cross Hospital.

IN the fire which, as stated last week (p. 49), destroyed the chemical laboratories of Cornell University, several members of the staff appear to have lost very valuable records and data, the work of years. We learn from *Science* that many notes of experiments and researches, manuscripts, and treasured records have been lost. In a business house such records would be placed in a fire-proof safe every day when not required, but the use of safes in laboratories is very rare. Perhaps the fire at Cornell University will lead to the introduction of fire-proof rooms or safes in all laboratories where records of original work are kept, in order to avoid the destruction of scientific material upon which no monetary value can be placed because it is unique.

IT is announced in the issue of *Science* for March 3 that the University of Buffalo has received actual and provisional endowment for the new department of arts and sciences amounting to 150,000*l.*; 20,000*l.* of this sum to be given outright by Mrs. Seymour H. Knox, who, with her children, proposes to increase this eventually to a total of 100,000*l.*; 50,000*l.* is given by General E. Hayes, for the first building upon the University site, provided 200,000*l.* be raised for like purposes before June, 1919. From the same source we learn that President Goodnow, at the commencement exercises of the Johns Hopkins University, on February 22, announced that the Consolidated Gas Company of New York, the American Gas Company of Philadelphia, and the Consolidated Gas Company of Baltimore, had interested themselves in the establishment of a laboratory at the University for research work as to the possibilities of coal-tar products. The purpose is to develop the aniline dye industry and other important branches in the coal-tar field.

THE experiment of holding a "Summer Assembly in Science" at the Scripps Institution for Biological Research at La Jolla, on the sea coast near San Diego, will be tried by the University of California next summer for the first time. The purpose is to disseminate among teachers and others interested in modern science the discoveries and new points of view which are resulting from the investigations of the research department of the University. There will be lectures, conferences, and demonstrations every afternoon of the six weeks by members of the scientific staff of the institution, and Tuesday and Thursday mornings will be devoted to lectures, laboratory, museum, and field work for small groups of students on the characteristic animal and plant life of the ocean waters along the shore of southern California. A course on "Local Coastal Physical Geography" will be conducted by Mr. W. C. Crandall, who as master of the *Alexander Agassiz*, the institution's sea-going scientific collecting vessel, has wide familiarity with the California coast. Half a mile of ocean frontage, with cliffs, sand beaches, and tide pools inhabited by a wide variety of sea-life, is the ideal locality which the Scripps Institution for Biological Research occupies. Any persons interested in science who wish to attend the assembly at the Scripps Institution from June 25 to August 5 next are requested to write as soon as possible to Prof. William E. Ritter, scientific director of the institution, at La Jolla, so that proper provision may be made.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 16.—Sir J. J. Thomson, president, in the chair.—C. **Reid** and J. **Groves**: Preliminary report on the Purbeck Characeæ. The investigations, in aid of which a Government grant was made, relate to the remains of Characeæ found in the cherts and limestones of the Middle Purbeck beds of Dorset. A large amount of new material has been collected, and by treating the limestones to a long-continued drip of slightly acidulated water it has been possible to obtain specimens throwing much additional light on the structure of these plants. The principal results obtained up to the present are:—(1) The discrimination of a new genus, Clavator, characterised by (*a*) the production of remarkable thickened club-like nodes; (*b*) the presence of a utricle enclosiig the oogonium; (*c*) the production of numerous rosette-like groups of clavate processes on the stem and branchlets. (2) The discovery of a number of different types of fruit and vegetative parts showing that the Chara-flora of the period was rich and varied. The remains found belong to both divisions of the family Chareæ and Nitelleæ.—Prof. H. G. **Plimmer**: Notes on the genus Toxoplasma, with a description of three new species. Organisms bearing the above name have been found in the rabbit, gondi, dog, mole, and pigeon during the seven years that have elapsed since their discovery by Splendore in Brazil. Their systematic position is uncertain, but they are widely distributed geographically and as regards hosts. They are found as parasites in the mononuclear leucocytes, in which they occur in large numbers. Those described in the paper were found in a Fossa from Madagascar, in a fruit pigeon from the Aru Islands, and in a Say's snake from Mexico, this latter being the first found in a reptile. The results of the study of these parasites in the above-named animals point rather to their relationship with the Hæmogregarines than with the Leishmania or the Yeasts, as has been suggested.—F. **Sano**. The convolutional pattern of the brains of identical twins, a study on hereditary resemblance in the furrows of the cerebral hemispheres. This monograph is a contribution to the study of the comparative morphology of relative brains inaugurated by Spitzka, Karplus, and Schuster. Its interest lies in the fact that it describes the brains of identical twins. It also includes a study of nerve plexuses and other morphological points of interest, thus serving as a morphological contribution to the observations of the late Sir Francis Galton on the history of twins.

Royal Meteorological Society, March 15.—Major H. G. Lyons, president, in the chair.—Sir Napier **Shaw**: The meteorology of the globe in 1911. The year 1911 is still remembered for its fine, warm summer. As the sequel of a long series of discussions at meetings of the International Meteorological Committee and its commissions, the International Solar Commission, the International Commission for Maritime Meteorology and Storm Warnings, the International Commission for Réseau Mondial, as well as the Solar Physics

Committee of the Board of Education, which, through the Solar Physics Observatory at South Kensington, was concerned with the relation of solar and terrestrial phenomena, especially rainfall, the committee of the Meteorological Office authorised the preparation of an annual statement of the meteorology of the globe beginning with 1911. The volume for that year is now nearly ready for issue. It gives particulars of pressure, temperature, and rainfall for available stations in all parts of the globe at the rate of two stations for each 10° square of latitude and longitude. It also gives the differences from the normal in those cases in which normals existed or could be compiled. The values are given in absolute units for pressure and temperature. Positive and negative signs are therefore only used to indicate differences from normal, except in two cases of negative sign in the column for height which indicate that the stations are below sea-level. A brief discussion of the meteorology of the year is based upon the differences from normal.

Manchester.

Literary and Philosophical Society, March 7.—Prof. S. J. Hickson, president, in the chair.—D. **Thoday**: Optical properties of chlorophyll. The author referred to the importance of chlorophyll, which enables green plants to utilise radiant energy from the sun in the synthesis of organic food substances from the carbon dioxide of the atmosphere. On this process the whole organic world, with few exceptions, directly or indirectly depends. A few classes of bacteria, *e.g.* the iron and the sulphur bacteria, are independent of organic substances, making use of carbon dioxide in *chemosynthesis* by means of chemical energy, liberated in the oxidation of ferrous carbonate and sulphuretted hydrogen respectively. In the green plant the direct utilisation of sunlight in *photosynthesis* depends on chlorophyll, and this fact makes the optical properties of chlorophyll of especial interest. Mr. Thoday demonstrated the red fluorescence of a chlorophyll solution, remarking that the sensitising action of this and other fluorescent pigments on photographic plates, and their toxicity to protozoa in extremely dilute solution only in the light, suggest that such pigments when exposed to light are especially active chemically.—Dr. H. G. A. **Hickling**: Variation in the colour of coal streaks. The colour of coals varies in proportion to the different amounts of carbon in the coals. The author exhibited a number of samples of the fluorescent solutions obtained by washing finely-ground coal-powder with benzene. He pointed out that the constituent of the coal dissolved by the benzene appears to be more especially characteristic of the bituminous or humic types of coal, little or no colour being obtained when the Cannel coals or anthracites are similarly treated.

Edinburgh.

Royal Society, February 7.—Dr. J. Horne, president, in the chair.—J. M. **Thompson**: The anatomy and affinity of *Platyzoma microphyllum*. The paper dealt with the anatomy of a single specimen of the plant. There were simply-pinnate unbranched leaves springing from the upper surface of the condensed and horizontal rhizome, and small filiform leaves devoid of pinnæ inserted on the sides and lower surface of the rhizome. Between these two leaf types transitions were found. The heterophyly is considered a consequence of the adoption of the rhizomatous habit. A dichotomised pinnate leaf was described. The stele was of a unique type, and the sporangia, of which there were two types, large and small, were characterised by irregularities in form and variability in position of the annulus. The systematic position of the Platyzoma cannot yet be determined, and until fuller information regarding the nature of the spores is obtained it is proposed to leave Platyzoma in the Gleicheniaceæ.—Dr. R. C. **Davie**: The leaf trace in some pinnate leaves. This was a continuation of the former paper on the pinna trace in the ferns. Species of Polypodium from the forests and open sea coast in Brazil showed no variation in the method of giving off of the leaf trace, but modified the abaxial side of the leaf trace, increasing the number of strands where the leaves were long and heavily pinnate, decreasing them in short leaves. In species of Aspidium, Dryopteris, Polystichum, and other genera collected in Brazil it was found that the abaxial strands of the leaf trace were used directly in the supply of the pinnæ where these were large. With few exceptions the type of pinna trace is constant throughout a genus. The abaxial side of the leaf trace is dependent on local and individual peculiarities. Comparisons were made with the leaf trace of Cycads and of Monocotyledons and Dicotyledons.

Paris.

Academy of Sciences, March 6.—M. Camille Jordan in the chair.—Pierre **Duhem**: The electrodynamics of conducting media.—M. **Liapounoff** was elected a correspondant for the section of geometry in the place of the late Paul Gordan.—Ernest **Lebon**: A new table of divisors of numbers.—Charles **Rabut**: New inverse invariants.—MM. **Girardeau** and **Bethenod**: The regulation of the charging circuit in installations of wireless telegraphy, using continuous high-tension current with rotating contact-breaker. Commenting on two recent notes of M. Bouthillon, it is pointed out that the proposed regulation is not new. References made to publications on this subject, dating from 1910.—A. **Bach**: A new reaction of urine. Nitrates are reduced in animal tissues by the joint action of a ferment and a co-ferment, neither of which separately possesses a reducing action. Both are present in fresh milk, and it is now shown that normal urine contains appreciable quantities of the co-ferment.—Jules **Welsch**: The geological constitution of the Poitou marshes.—Stanislas **Meunier**: Observations on the absence of the pelagic facies in the sedimentary series.—F. **Garrigou**: The age and mode of formation of water at the surface of the earth.—Fernand **Goud**: A new method of employing formol for disinfection at the front. Use is made of the vapours given off when formol (40 per cent. solution) is poured into a saturated solution of potassium permanganate. Direct experiment has proved that sterilisation of clothes by this method is more rapid than when day heat is used. Details of the process are given.—C. **Galaine** and C. **Houlbert**: A sulphur dioxide diffuser for disinfection and rat killing in the trenches, in hulls of ships, and in houses. The apparatus proposed consists of a vessel of liquid sulphur dioxide, a heating coil and a fan. The apparatus is claimed to be compact, easily manipulated, and efficient in action.—Auguste **Lumière**: The action of the hypochlorites on pus. It has been shown by M. Delbet that when pus is added to double its volume of Dakin's solution (0·6 per cent. sodium hypochlorite) sterilisation is not usually effected, and, indeed, for some organisms, increased vitality results. Experiments with pus containing various micro-organisms (tetanus, streptococcus, staphylococcus, etc.) show that when a quantity of sodium hypochlorite is added to pus insufficient for sterilisation, the organisms are rendered less virulent and their toxins are destroyed by oxidation. This destruction of toxins regenerates the culture medium (pus), hence the increased growth in M. Delbet's experiments. But the destruction of the toxins *in vivo* is favourable to the body resistance since it permits the intervention of the phagocytes.

BOOKS RECEIVED.

The Structure and Properties of the More Common Materials of Construction. By G. B. Upton. Pp. v+327. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10s. 6d. net.

A Text-Book of Practical Physics. By Dr. H. S. Allen and H. Moore. Pp. xv+622. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

Institution of Electrical Engineers. Wiring Rules. Seventh edition. Pp. 54. (London: E. and F. N. Spon, Ltd.) 6d.

Catalogue of the Fresh-Water Fishes of Africa in the British Museum (Natural History). By G. A. Boulenger. Vol. iv. Pp. xxvii+392. (London: British Museum (Natural History); Longmans and Co.) 30s.

Electrical Apparatus Making for Beginners. By A. V. Ballhatchet. Pp. 164. (London: P. Marshall and Co.) 2s. net.

The Meaning of Dreams. By Dr. I. H. Coriat. Pp. xiv+194. (London: W. Heinemann.) 5s. net.

Sleep and Sleeplessness. By H. A. Bruce. Pp. ix+219. (London: W. Heinemann.) 5s. net.

Human Motives. By Prof. J. J. Putnam. Pp. xvii+179. (London: W. Heinemann.) 5s. net.

Warwickshire. By J. H. Bloom. Pp. xi+144. (Cambridge: At the University Press.) 1s. 6d. net.

A Handbook of Colloid-Chemistry. By Dr. W. Ostwald. Translated by Prof. M. H. Fischer. Pp. xii+278. (London: J. and A. Churchill.) 12s. 6d. net.

A System of Physical Chemistry. By Prof. W. C. McC. Lewis. Vol. i., pp. xiv+523. Vol. ii., pp. vii+552. (London: Longmans and Co.) 9s. net each.

A History of British Mammals. By G. E. H. Barrett-Hamilton and M. A. C. Hinton. Pp. xviii. (London: Gurney and Jackson.) 2s. 6d. net.

Canada. Department of Mines. Mines Branch. Petroleum and Natural Gas Resources of Canada. Vol. ii., Description of Occurrences. Part i., Eastern Canada. Part ii., Western Canada. By F. G. Clapp and others. Vol. viii+404. (Ottawa: Government Printing Bureau.)

Mathematical Notes, published by the Edinburgh Mathematical Society. Edited by Dr. P. Pinkerton. Nos. 14, 15, 16. (Edinburgh: Mathematical Society.)

Ministry of Finance, Egypt. Survey Department. The Magnetic Survey of Egypt and the Sudan. By H. E. Hurst. Pp. 53. (Cairo: Government Press.) P.T. 10.

The National Physical Laboratory. Notes on Screw Gauges. Enlarged issue, February 1. Pp. 29. (Teddington: W. F. Parrott.) 1s. 6d.

DIARY OF SOCIETIES.

THURSDAY, MARCH 23.

ROYAL SOCIETY, at 4.30.—The Main Crests of Ship Waves, and Waves in Deep Water due to the Motion of Submerged Bodies: G. Green.—Investigation of Atmospheric Electrical Variations at Sunrise and Sunset: E. H. Nichols.

ROYAL INSTITUTION, at 3.—Organic Products used as Propulsive and Explosive Agents: Prof. H. E. Armstrong.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Annual General Meeting.—Presidential Address: Sir Richard A. S. Redmayne.

FRIDAY, MARCH 24.

ROYAL INSTITUTION, at 5.30.—The Mechanism of Chemical Change in Living Organisms: Prof. W. M. Bayliss.

PHYSICAL SOCIETY, at 5.—A New Method of Determining Ionic Velocities: Mrs. Griffiths.—(1) An Explanation of the Migration of Ions; (2) A Method of Exhibiting the Velocities of Iodine Ions in Solution: Dr. S. W. J. Smith.

SATURDAY, MARCH 25.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

ESSEX FIELD CLUB (at the Essex Museum, Stratford), at 3.—Annual Meeting.—Prehistory in Essex, as Recorded in the Journals of the Essex Field Club: S. Hazzledine Warren.

MONDAY, MARCH 27.

ROYAL SOCIETY OF ARTS, at 4.30.—Surveying: Past and Present: E. A. Reeves.

TUESDAY, MARCH 28.

ROYAL INSTITUTION, at 3.—Modern Horticulture—Plants and the Seasons (Seasonal Rhythm): Prof. F. Keeble.

ROYAL SOCIETY OF ARTS, at 4.30.—Next Steps in Empire Partnership: P. Hurd.

ROYAL ANTHROPOLOGICAL INSTITUTE (with the Prehistoric Society of East Anglia), at 2–4.—Grime's Graves and Allied Cultures: Dr. A. E. Peake.—The Pleistocene Succession in England: A. S. Kennard. At 5–7.—Hand Grips: Miss N. Layard.—Irish MS. and other Evidence of the Use of Stone Weapons, including Smooth Stone Celts within Historic Times: Rev. F. W. Hayes.

WEDNESDAY, MARCH 29.

ROYAL SOCIETY OF ARTS, at 4.30.—Pan-German Aspirations in the Near East: Dr. R. W. Seton-Watson.

INSTITUTE OF METALS, at 4.—Presidential Address. At 8.—Third Report to the Corrosion Committee: W. E. Gibbs, R. H. Smith, and Dr. G. D. Bengough.—The Electrolytic Method of Preventing Corrosion: E. Cumberland.—Note on some Tin-Aluminium-Copper Alloys: Prof. A. A. Read and R. H. Greaves.—Notes on the Analysis of Aluminium and its Alloys: W. H. Withey.—The Annealing of Nickel Silver: F. C. Thompson.—Electric Furnaces as applied to Non-ferrous Metallurgy: Prof. A. Stansfield.—Transformations in Alloys of Gold and Copper: Dr. N. S. Kurnakow, S. Zemczuzny and M. Zasedatelev.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.

CHILD STUDY SOCIETY, at 6.—The Child Delinquent: C. M. Chapman.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 5.30.—The Spectra of Hydrogen and Helium: Prof. A. Fowler.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

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THURSDAY, MARCH 30, 1916.

EARLY EMBRYOLOGY OF THE WORKER BEE.

The Embryology of the Honey-Bee. By Dr. J. A. Nelson. Pp. 282. (Princeton: University Press; London: Oxford University Press, 1915.) Price 8*s*. 6*d*. net.

THE author of this book describes himself as Expert in Bee Culture Investigation, Bureau of Entomology, U.S. Department of Agriculture. From such an expert one would naturally expect a book full of interesting particulars about the modifications of development in the bee induced by the social habits of this insect and its method of feeding its young. The reader who entertains any such expectation will be severely disappointed; the book deals only with the early development of the egg of the worker bee, and carries the life-history only to the stage when the bee escapes from the egg-shell and begins its life as a grub inside a cell of the honeycomb.

The book, therefore, is almost without significance for the bee-culturist, but from the point of view of the student of comparative embryology it is a production of very great interest, and is to be warmly commended. It comprises a most painstaking and detailed study of the processes of segmentation and "formation of the layers" in the bee's egg, followed by a full and satisfactory description of the development of the nervous system, of the respiratory system, muscles, heart, genital organs, etc. It might, indeed, be regarded as a first-class elementary text-book on insect embryology were it not for the obvious fact that the bee is not a very good choice as a type of insect development. But the comparative embryologist must often choose the types which he can get, not those which he would prefer, and as the first pre-requisite of sound embryology is to obtain abundant material comprising stages separated by very short intervals, it must be admitted the bee offers a better opportunity of accomplishing this end than many more primitive insects. The segmentation of the mesoderm is, however, much less marked in the bee-embryo than in the lower types, and no vestiges of abdominal appendages appear in the course of the development.

On practically every point the author confirms the conclusions arrived at by Hirschler in his study of the development of the beetle Donacia, which is by far the most thorough and satisfactory investigation of the development of any insect which had appeared up to the date of its publication (1909). All our ideas on the early stages of insect development had been thrown into confusion by Heymons. This author asserted that in the higher insect the endoderm, which in the lower types forms the epithelium of the mid-gut, had totally disappeared, and that in these higher types this epithelium was formed from two bands of cells of ectodermic origin attached to the inner ends of the stomodæum and proctodæum respectively. These conclusions of Heymons were frequently used to discredit the doctrine of the fundamental importance of the distinction between the germ-layers, a doctrine which all recent and careful research has tended to re-establish and extend. Hirschler showed that Heymons had confounded an earlier pair of invaginations of the outer cells into the yolk, which can be compared to the process of gastrulation in less yolky eggs, with a later and totally distinct pair of similar invaginations which give rise to the stomodæum and proctodæum. The reader will find that Hirschler's statement receives valuable and convincing confirmation in the volume before us.

The book is well illustrated, most of the figures being interspersed with the text in the vicinity of the portions to which they refer, whilst some plates giving excellent representations of the whole egg in various stages of development are collected at the end. The book will prove to be an indispensable adjunct to every zoological library.

E. W. M.

SOCIOLOGY AS A SCIENCE.

Outlines of Sociology. By Prof. F. W. Blackmar and Prof. J. L. Gillin. Pp. viii+586. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.

THE ancient academic problem of "free will" is always with us; the study of it is never barren, for its meaning changes with the development of society and of social intelligence. As compared with the state of the problem in the time of Hume, for example, the present-day aspect of it is decidedly more clear and scientific. It may be put in Cooley's words: "no man really acts independently of the influences of his fellow men." "Everywhere," so Profs. Blackmar and Gillin put it, "there is a social life, setting limitations and predominatingly influencing individual action. In government, in religion, in industry, in education, in family association—in everything that builds up modern life, men are co-operating. They work together, combine and organise for specific purposes, *so that no man lives to himself.*"

Sociology has often been derided as a pseudo-science; but in its early stages every science has received the same contumelious treatment. Chemistry was once alchemy; astronomy was once astrology. But British, American, French, and German thought has sealed the success, or at least the usefulness, of the youngest of the sciences, which, after all, is one of the oldest; Plato's "Republic" is a sociological investigation. And, *a priori,* if there is order in the process of society-building; if "through it all runs a constant purpose, a social trend; if there are laws controlling the movement of human society; forces in continual action impelling it forward in well-defined lines"—then there is clearly a mass of facts capable of classification, social phenomena more or less frequently recurring, and movements

more or less regular, which admit of scientific study and analysis. As for the relation of sociology to other social sciences, "while economics, political science, or ethics may deal with specific laws relating to parts of society, sociology deals with the general laws which apply to the whole structure"; "it occupies much the same position with reference to the social sciences that biology holds to the natural sciences dealing with organic phenomena."

Sociology is essentially a co-operative study; no great individual genius can epitomise it and stamp it with his own theory. What the "social mind" is to society, sociology, in a sense, is to the social sciences; and, as Ellwood says, "the term social mind is a convenient term to express the unity of our mental life." One danger that may threaten sociological science is the possibility of becoming academic. Few studies have more inducements for the armchair philosopher. The cure for this tendency is in the highest ideal of sociology, viz., creative work in the amelioration of social pathology. The only sphere for the realisation of this ideal is field-work, the study of living conditions. To this all antiquarianism and historical investigation must be subordinated. For instance, an investigation into the causes of poverty in a particular country, carried out personally, would be a valuable factor for progress. It is just in this kind of creative work that the State can make use of the science, as it is beginning to do, while the science should place itself at the service of the State. This is true of every science. But the duty of the State is no less plain: it must encourage, organise, and subsidise all the sciences, without the cumbrous pomp and delays of Royal Commissions, but on simple business lines.

The war has begun to drive home this elementary truth. At the stage of civilisation now attained, it is preposterous that the State should not realise its function and duty—that is, to secure the increasing well-being of the society and the individuals over whom it presides. To effect this result is impossible on merely political and legal bases; science is the only sane foundation of national prosperity and progress, and therefore the main concern of the State should be with science. And sociology is a sort of middle-man between the sciences and their utilisation by the State. There is probably not a single department, either of the social or individual life (the political counts merely as a phase of the social, artificially maintained in relation to the State) which is not more or less haphazard in its theory and practice. We do not want to substitute for painful experience and rule-of-thumb any theoretical fads, but we may certainly claim, in a scientific age, that the best results of applied science should form the material for State-development of the national possibilities. Otherwise we are left with the barbarous creed of *laissez-faire,* of which "muddle through" is the proper and most apt translation.

Everything of the best in recent sociological interpretation seems to be included in this text-book of Profs. Blackmar and Gillin; it is quite the most impartial, reasoned, and sound of *résumés* of the subject, most of which, by the way, together with original theory, has recently emanated from America.

To illustrate the needs of a relation between sociology and the State, the authors' remarks on "social surveys" are in point. They mention the great work of Mr. Charles Booth, "who devoted his fortune and a great part of his later life to a study of social conditions in London," also Mr. Rowntree's study of York, Miss Jane Addams's "Hull House Maps and Papers," and others. "A number of places have introduced this method of social stocktaking." But "as practised at the present time by the professional, social, and educational surveyor, it is liable to be brought into disrepute." "There is great need of a standardisation of methods and a perfecting of technique." In other words, there is needed for this, as for every other sociological survey and any practical application of science to national purposes, a central organisation. Such can only be supplied by the State, but there is always the danger of that *corruptio optimi,* red tape, of which, however, the best cure is scientific training.

A. E. CRAWLEY.

EUCLID'S BOOK ON DIVISIONS OF FIGURES.

Euclid's Book on Divisions of Figures, with a Restoration based on Woepcke's Text and on the "Practica Geometriae" of Leonardo Pisano. By Prof. R. C. Archibald. Pp. viii–88. (Cambridge: At the University Press, 1915.) Price 6*s.* net.

A TYPICAL problem of the *Divisions* is "to cut off a certain fraction from a given triangle by a line drawn from a given point within the triangle." Of the thirty-six propositions of the book, six are auxiliary, two deal with areas the boundaries of which are partly or wholly circular; the rest are concerned with the division of triangles and quadrilaterals. For several reasons the treatise is very interesting; it is apparently complete, the Arabic text[1] translated by Woepcke (*Journ. As.*, 1851) seems to represent Euclid's text, and although the same cannot be said about the proofs supplied by Leonardo of Pisa (Fibonacci), they retain a great deal of the old Greek style. The peculiar fact that shows how, even early in the thirteenth century, geometry, as understood by the ancient Greeks, had become infected by arithmetic, is that Leonardo constantly gives numerical illustrations, and even refers (p. 41, note) to segments defining a given ratio as "numbers," which we may be sure Euclid would not do in this context. Since the editor's translation of Leonardo is not absolutely literal we must not lay stress on the passage (p. 61):—"Apply a rectangle equal to the rectangle *zb*. *l*

[1] This contains the enunciations only.

to the line *bi*, but exceeding by a square; that is, to *bi* apply a line such that when multiplied by itself and by *bi* the sum will be equal to the product of *cb* and *bi*," the explanatory clause being possibly Dr. Archibald's; but however that may be, this sentence is a good illustration of the contrast between Greek methods and others.

The editor's work seems to be very well done. There is a historical introduction (pp. 1–28); the restoration of the treatise (pp. 30–77), which gives a translation of Woepcke's version of the Arabic, and a close paraphrase of Leonardo's proofs when they exist, with supplementary matter by the editor indicated by brackets or different type; and a bibliography (1539–1911) which gives references to works on "division" problems covering a very wide range—some, for instance, leading to transcendental equations.

If the Cambridge Press would issue this work, to teachers at any rate, in a paper wrapper at half-a-crown, it might have a larger circulation. The book deserves to be well known on account of its ingenuity and the light which its history throws on the different phases of geometrical theory. G. B. M.

OUR BOOKSHELF.

A Laboratory Manual for Work in General Science. By O. W. Caldwell, W. L. Eikenberry and C. J. Pieper. Pp. xi+134. (London: Ginn and Co., 1915.) Price 2*s.* 6*d.*

THIS little manual, emanating from the School of Education of the University of Chicago, gives outlines of experiments and demonstrations for use "in the first year of the high school." The experiments adopted are stated to be the "result of the co-operative work of several high school teachers through a period of years." Their purpose is "to direct the pupils into the habit of finding out about many kinds of common problems in science." Useful as some of the experiments are to create a healthy interest in everyday phenomena, the course described covers so many different fields and the experiments follow each other with so little regard to sequence, that the net result would probably be to impart very unreal and superficial knowledge. In successive experiments we have such abrupt transitions as the following: No. 23. Does a liquid fill all the space which it appears to fill? No. 24. What are the parts of a flame? And, again, No. 43. How do bacteria act on milk, and how may milk be preserved? No. 44. What changes in volume take place when water freezes? No. 49. Does water evaporate in a plant? No. 50. How does a siphon work?

Exercises such as No. 61. What is the relation between water supply and disease? No. 61*a*. What is the significance of the local death-rate from typhoid? No. 62. How is sewage disposed of in your community? are examples of later problems. These are followed by exercises dealing with the use of pulleys and machines, experiments on the soil, the growth of plants, the nature of foods, and so on. Finally we have a statistical study of the question, "Are variations in parents transmitted to offspring?"

In the reviewer's opinion, far too much is attempted in the course laid down for it to be of much real educative value. W. A. D.

Archaic Sculpturings: Notes on Art, Philosophy, and Religion in Britain, 2000 B.C. to 900 A.D. By L. M. Mann. Pp. 52. (London: W. Hodge and Co., 1915.) Price 2*s.* 6*d.* net.

THE object of this pamphlet, reprinted from the Proceedings of the Dumfries and Galloway Natural History and Antiquarian Society, is to examine three groups of sculptures in that district: Pagan, consisting of cup and ring markings of the Neolithic and Bronze Ages, and diagrams on slate of the Middle Bronze Age; transitional designs, mostly of the Iron Age; and the earliest Christian monuments. The scheme is wide, probably too wide for treatment within the limits of a single paper. The most interesting part of it is the investigation of cup and ring markings. The current theories of their origin and purport being far from satisfactory, Mr. Mann tells us that some years ago he began to recognise that these figures, when plotted on paper, were found to be "arranged in a most precise, mathematical, and geometrical manner." He recognises two main systems of lines fitting into the salient parts of the sculpturing. "One system narrowly misses coinciding with the other. One is related apparently to the actual pole, and the other to the pole star of that period." He believes that many of them "embody primitive astronomical motives mixed up with ideas of worship of a Supreme Central Force which were widespread over most parts of Europe during the first, probably the second, if not also the third millennium before Christ."

The scheme is worked out with considerable ingenuity. But the student will probably demand further evidence, beyond the carvings themselves, to show that these beliefs were current among the sculptors, some precise dating of the ornamentation, and a more extended survey of similar markings beyond the area treated in this paper. The theory is, at any rate, interesting, and those who are in a position to examine these stones might bear it in mind.

Warwickshire. By J. Harvey Bloom. Pp. xi+144. (Cambridge: At the University Press, 1916.) Price 1*s.* 6*d.* net.

THIS little volume exhibits all the excellences we have learnt to associate with the Cambridge county geographies. Visitors to Warwickshire will find here a concise and well-illustrated account of the relief, geology, natural history, climate, and industries of the county, in addition to other interesting particulars about one of the most beautiful parts of England. The coloured orographical and geological maps add greatly to the value of the guide.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Optical Glass: an Historical Note.

THE subject of optical glass is, at the present time, one of such paramount importance that no apology is needed for introducing it to the attention of your readers. As is well known, the Rev. Vernon Harcourt and Sir George Gabriel Stokes, in the earlier half of last century, laboured together for more than twenty-five years with the object of adding to our stock, new varieties of optical glass, but without success. Their labours, however, were afterwards continued by Prof. Abbe and Dr. Schott, of Jena, who, in the course of some five years, were completely successful. As the result of a critical examination of the work of the English workers, Dr. Czapski—then the head of the firm of Carl Zeiss, of Jena—came to the conclusion that Harcourt and Stokes had failed simply because they had not at their disposal the services of a sympathetic and competent glass-maker.

I have quite recently, by the courtesy of a friend, enjoyed the privilege of reading a number of letters, I believe as yet unpublished, written by Prof. Abbe, during the period of his work on optical glass, to a well-known English microscopist, now dead. One of these letters, dated October 9, 1881, is very interesting because it sets out very clearly the high-water mark in optical construction attained by optical glasses commercially obtainable before the Jena glasses were produced. The relevant part of this letter reads as follows:—

"The Crown and Flint which is applied now by Zeiss—for objectives, prisms, etc.—is within the limits of 1·5017 and 1·8017 refractive index for the D-line. The dispersion of the former is 0·00798, and of the latter 0·03287, measured for the interval between lines C and F. The density of the said Crown is approximately 2·40, and of the said heavy flint 5·1. The Crown above is not the ordinary Crown, which yields $n_D = 1.515 - 1.520$ and $n_F - n_C = 0.00850 - 0.00900$; it is a special glass of Feil (of Paris). The Flint named above—also from Feil—is not perfectly white, but the colour (yellowish) is not very perceptible in smaller pieces (lenses or prisms). It may be usefully applied for many purposes, though it leaves a rather great residual of secondary chromatism.

"Feil has made still more refractive Flint, approaching 1·9 in index. But this is strongly coloured and not fit for use in my opinion. The common Flint, which is applied for telescope-objectives, has N_D between 1·60 and 1·63, and $N_F - N_C$ between 0·0165 and 0·0180. The strongest Flint, which is made by Chance Brothers, of Birmingham (*i.e.* 'double-extra-dense' Flint), has $N_D = 1.71 - 1.72$ and $N_F - N_C$ between 0·0239 and 0·0241.

"All taken together, we have eighteen different kinds of Crown and Flint in constant use at Dr. Zeiss's workshop."

It is interesting to note that at the time referred to in the above letter Zeiss was entirely dependent upon Chance Brothers, of Birmingham, and Feil, of Paris, for his supplies of optical glass.

The research work commenced by Abbe and Schott in 1881 on a laboratory scale was so far successful that Prof. Abbe, writing in a second letter on February 21, 1883, says:—

"Regarding the glass experiments, of which I have told you a year ago, I may say, that they have had a very satisfactory progress, as well in regard to the purely scientific aims, for which the research had been undertaken, as in regard to the practical results which are obtained. We are now satisfied that the utilisation of these results for the fabrication of optical glass will be the basis of a good progress of practical optics in several respects. The question is now only how to introduce the results of the experimental research into the fabrication; for all that can be done in the laboratory is settled now, or nearly settled. For that other aim I have had already, during several months, long and troublesome negotiations in order to obtain for my fellow-labourer that assistance which could enable him to undertake the practical application of the long research. Even now, however, it is not yet settled that this will be possible—at least in the manner as it has been planned until now, and within a moderate time. But at all events, the quick utilisation of the research in favour of microscopic optics will not be questionable; we have obtained already, or will obtain within the next time, by mere laboratory operations, sufficient quantities of the new glasses, which are of interest for the microscope, for enabling Zeiss to begin with the practical application in this year (which notice, however, I request you to consider as a private one at present, because it would not be agreeable, to have this matter spoken of long before it is a matter of fact)."

This letter is very interesting, because it shows that at the time in question, so far as the comparatively small quantities of special glasses required for the production of microscope objectives was concerned, the laboratory output was sufficient to enable the work to be done. This fact at once points to the possibility of meeting the demand at the present time for very special glasses required in small quantities only, as, for example, the production of microscope objectives by laboratory rather than by factory methods.

The production of glass on a manufacturing scale was commenced at Jena in 1884, and was brought to a successful conclusion in 1886, when the first catalogue of the Jena glasses was issued.

The third letter written by Prof. Abbe is dated March 4, 1886, and was accompanied by one of the first—if not the first—homogeneous immersion apochromatic microscope objectives made. The letter reads as follows:—

"This is a homog. immersion of 1·40 apert. and 3·0 mm. focal-length, constructed by means of new kinds of optical glass which have been produced on the base of a systematical research into the optical qualities of the various elements admitting of vitrification. This research has been conducted through about three years in the way of laboratory work, chemical and optical, by myself and a fellow-labourer of the chemical and technical line (Dr. Schott) with the continuous assistance of two younger scholars, chemists and physicists; and has afterwards—nearly two years ago—induced the foundation—at Jena—of a technical establishment for the regular fabrication of all kinds of optical glass for general use. This glass-manufactory (which has been set up in 1884 by Dr. Schott, Messrs. Zeiss, and myself, with the aid of a subsidy of the Prussian Government) has taken up, and continued, the former experiments on the scale of fabricatory work, in order to make the results available for the various branches of practical optics. This is going on still—some tasks being settled (the production of the silicious glasses, which is in a regular fabrication since last summertime), other tasks being brought near to the aim. In the meanwhile, I have gone to work with theoretical research and computation; in order to find the proper formulas for the utilisation of the new

kinds of glass in the construction of telescope objectives and microscope objectives.

"Regarding the latter aim, a series of objectives adjusted for the short continental tube is nearly finished; another series for your English microscopes —which requires different formulas—has been begun; and you and Mr. —— have at hand the first specimens of that series.

"The optical features of the new constructions, which are represented by this 1/8th of 1·4 ap., may be defined in that way; the various corrections are of a higher order than could be obtained formerly (or, more strictly spoken, the residuals of the various corrections, i.e. the defects of collection of the rays, are of a higher order according to mathematical terminology. (1) With the old kinds of crown and flint glass two different colours only could be collected to one focus, a secondary spectre remaining uncorrected. With the new glass those different colours unite at one point, a tertiary deviation being left only. (2) Formerly the spherical correction was confined to the rays of one colour; this correction being made for the middle part of the spectrum, the systems remained under-corrected, spherically, for the red rays, and over-corrected for the blue rays. Now the correction of sph. aberr. is obtained for two different rays of the spectrum at the same time, and the objective shows the same degree of chromatical correction for the central as for the marginal part of the aperture. (Of course, this higher degree of correction is not given by the glass from itself—it requires a very careful utilisation of the optical properties of the various kinds of glass at disposal, in order to fulfil all those conditions, and this was not even possible except by means of a greater complication of the constructions; I was obliged to introduce five separate lenses (for the aperture 1·4) instead of the four applied hitherto).

"The objective at hand is constructed on the single-front-type. It contains ten single lenses in five separate parts. Two only of these ten lenses contain silicious acid; the glasses of the other eight are phosphates and borates—the Crown and Flint glass which has been used by the opticians hitherto, does not contain, as essential constituents, more than six chemical elements, O, Si, K, Na, Ca, Pb; the lenses of the 1/8th contain, as essential components of the glass, not less than fourteen elements."

"I did not introduce a greater aperture than 1·40 in order to preserve a convenient working distance—which, in fact, is =0·25 mm.=1/100 in. The two oculars sent with the objective are constructed with the aim to compensate certain aberrations outside the axis, which cannot be got rid of in the objectives (of wide aperture). The whole series of objectives, high and low powers, shall be so arranged, that this compensation is always obtained by the same series of oculars."

This last letter, I think, will be acepted as setting out *inter alia* in a remarkably lucid way the optical advantages obtained by the introduction and employment of the Jena glass in optical constructions.

F. J. CHESHIRE.

Hamilton and the "Quantification of the Predicate."

IN NATURE for March 23, p. 78, in a review of De Morgan's "Budget of Paradoxes," re-issued by the Open Court Publishing Co., there is an allusion to Sir William Hamilton's "famous theory of the quantification of the predicate."

This theory was first set out by George Bentham, a nephew of Jeremy Bentham, in 1827, in his "Outlines of Logic," reviewed by Hamilton in the *Edinburgh Review* in 1833, and again raised by Mr. Warlow in the *Athenaeum* at the end of 1850, as may be read in the *Contemporary Review*, May, 1873, pp. 821–24.

Although Bentham never pushed his theory, it is clear that it came into Hamilton's mind from Bentham's book, and, as so often happens, the actual originator has been overlooked.

B. D. J.

THE ARCHÆOLOGICAL SURVEY OF NUBIA.[1]

IN the accounts of the preceding reports which have been published in NATURE attention has been directed to the exceptional thoroughness of the work, both of excavation and surveying, and the completeness of the presentment of the new information brought to light in this important archæological survey, which has been carried out by the Egyptian Survey Department.

In the present report Mr. Firth has fully maintained the high standard of excellence; and the complete and lucid statement of the facts, the liberal supply of text-figures, and especially the admirable collotypes, enable the reader almost to see and fully to understand the whole of the work, without the discomfort of living in a Nubian camp.

It is a matter for congratulation that this important and difficult investigation was carried out with such insight and thoroughness, for the flooding of the country makes it impossible ever to survey Lower Nubia again for archæological information. Without the knowledge so acquired the door would have been shut for ever upon a proper understanding of the early history of the Sudan, which is now being revealed by Prof. Reisner's excavations in the Kerma basin. Moreover, many of the difficulties in interpreting the story of Egypt would have been quite insurmountable without this information to make clear what was happening south of the First Cataract.

Most of the volume is devoted to the primary object of such a report, viz., the detailed and impartial statement of all the facts brought to light. It includes a brief account of the town site of Pselchis, and a full account of the mode of construction and contents of every grave.

The special importance of this report, however, depends upon the fact that it deals so largely with the remains of the distinctively Nubian culture, of which, from the circumstances of the case, it must represent for all time the chief source of information. In the introductory twenty-four pages Mr. Firth gives a well-balanced and illuminating survey of the early movements of people in the Nile valley, in which he clearly defines the position and the distinctive cultural relations of the Middle Nubian people (the "C-group"). The only criticism that I have to make of his account of this interesting people is the wholly unwarrantable suggestion of "the possibility that the C-group represents an immigration from the south-west of a mixed Negro and Libyan stock from

[1] "The Archæological Survey of Nubia." Report for 1909–10. By C. M. Firth. (Cairo: Government Press, 1915.) Price L.E. 2.

Darfur (or Kordofan) at the close of the Old Kingdom" (p. 20).

There is no reason whatsoever for labelling Predynastic Egyptians formed one of these groups and the Middle Nubians another; but there was a buffer-population, the "B-group" of the archæolo-

FIG. 1.—Pottery deposit near Canteen or Customs House, Romano-Nubian period. From "The Archæological Survey of Nubia."

these people "Libyan." In prehistoric times there were groups of kindred peoples scattered along

FIG. 2.—Later C-group period. Large jar of black polished ware with incised and coloured patterns in imitation of basket-work. Cemetery 101, grave 38 Scale 1 : 6. From "The Archæological Survey of Nubia."

the Nile valley like beads upon a string, which reached from the Mediterranean to Abyssinia. The gists, between them to hinder free admixture either of blood or culture, but which itself was affected most intimately—in other words, was virtually enslaved—by the more powerful Egyptian people. The Egyptians themselves were subjected to the stimulating influence of contact with more virile races in the north, and advanced rapidly along the paths of material progress. The Middle Nubians were affected by the retarding influence of Negro admixture, and incidentally retained for many centuries and with relatively slight changes the arts and crafts which originally were the common heritage of both Egyptians and Nubians.

The archæological evidence relating to this instructive history has been set forth in a most lucid way by Mr. Firth.

The excellence of the way in which the Survey Department has carried out this work of archæological research and of the publication of its results makes one wish that the newly-established British Protectorate of Egypt may use the knowledge to put in order its Antiquities Department which is not only intimately related in a variety of ways to the proper financial administration of the country, but also has responsibilities for the proper care of monuments by which posterity will judge of the success or otherwise of British rule in Egypt.

G. ELLIOT SMITH.

THE SHACKLETON ANTARCTIC EXPEDITION.

THE news that arrived at the end of last week from the Shackleton Antarctic Expedition was of an unexpected nature. The *Aurora*, during a severe gale, broke loose from her moorings early in May, 1915, and drifted in the pack ice, suffering severe damage, until March 14, 1916, when she got free in 64° 30′ S. 161° E., and is now on her way to New Zealand. When the *Aurora* broke adrift, a number of officers and men were ashore, including Captain Macintosh, and were unable to rejoin the ship. The wireless telegrams received seem to indicate that ten men are thus left stranded at the Ross Sea base near Cape Evans. They were probably engaged in depôt-laying over the barrier in preparation for the arrival of Sir Ernest Shackleton and his party in their trans-continental march.

News received during the winter from South Georgia had already warned us that Sir Ernest Shackleton had been unlucky in meeting with an unfavourable season, and the weather in Australia suggests that the exceptionally severe conditions extend to the area of Antarctica south of Australasia. The ice in the Weddell Sea is known to be exceptionally variable in extent; and success in the exploration of that region will probably always be largely determined by the good or ill fortune of the explorers in regard to the ice conditions. An expedition which found the Weddell Sea as Weddell found it could do more in one season than in ten years under average conditions.

The continued absence of news from the *Endurance*—the ship which took the trans-continental party to the Weddell Sea—is disappointing, as it is thus still doubtful whether Sir Ernest Shackleton has begun his daring trans-Antarctic sledge journey, and whether a favourable base was established on the shore of the Weddell Sea. But the *Endurance* may well have delayed her voyage back as late as possible on the chance of Shackleton's return to the western base, and to allow the Weddell Sea parties to have a full season's work. No anxiety regarding the *Endurance* need be felt for another fortnight, and news of her safe arrival at the Falkland Islands may be received any day.

The news from the Ross Sea demands more immediate preparation; for though the latest dispatch from the *Aurora* shows that she is seaworthy, she is admittedly so badly strained that it is possible that she may be too injured to be trusted with the relief of the party left at Macmurdo Sound. The explorers left there should be quite safe. They have two huts, both of which appear to be sound. Half the heating arrangements of the *Discovery* hut were left behind in New Zealand, and it was not lined with the insulating material taken out to render it heat-proof. But either hut would furnish safe shelter, and the stores left at this base must be ample for the men left ashore, and for Sir Ernest Shackleton and his party. Moreover, plenty of penguins and seals can be found. It is, however, clear that unless the *Aurora* can be repaired in Australasia, another ship must be sent out; for a relief expedition must go to the Ross Sea next season.

The absence of news from the *Endurance* is embarrassing, as it may be that another or even two other relief expeditions may be required. If the *Endurance* does not return within a fortnight, arrangements will have to be made for the dispatch of a relief ship to the Weddell Sea. Probably one of the South Georgia whalers might be sent on this mission; but as the South Atlantic is so much nearer than the Ross Sea there would be ample time to send out a suitable ship from this country. It must also be remembered that if Sir Ernest Shackleton started on his daring journey and has not reached either Macmurdo Sound or returned to his Weddell Sea base, it will be necessary to search for him; for he may have reached some place on the coast, where he could live through the winter on seal and penguin. No final decision can be made until time has been allowed for the return of the *Endurance*, but a full scheme of operations should be ready for definite action shortly after the arrival of the *Aurora* and the last day upon which we may reasonably expect this season the return of the *Endurance*.

RICHARD DEDEKIND.

THE death of Dedekind deserves more than a passing notice because he belonged to that small class of profound and original mathematicians typified by such men as Hermite, Kronecker, and H. J. S. Smith. In at least four great branches of pure mathematics he made contributions of the highest importance, and, as a tribute to his memory, a brief account of them will be given here.

It is now becoming a matter of common knowledge that the very foundations of all mathematics have been reconstructed in such a way as to make the science like symbolical logic, and, in theory, independent of all intuition whatever. The beginning of this revolution was the acquirement of a precise conception of irrational numbers, and of the nature of the arithmetical continuum. Dedekind shares with Heine, Kronecker, and Cantor the glory of making this theory complete. His own exposition is contained in the two tracts, "Was sind u. was sollen die Zahlen?" and "Ueber Stetigkeit u. irrationale Zahlen," and in some ways is the simplest and most philosophical of all that have been devised. It may be remarked also that he did this novel work without inventing more than one new symbol. He also shares with Cantor the credit of pointing out that, if we are to assume that the uniform motion of a point along a segment AB is an exact image of a real numerical variable increasing from a to b, we must introduce an axiom of some sort. This axiom, known as the Cantor-Dedekind axiom, may be put into various equivalent forms; one of them is that any definite segment of a straight line must be terminated by two definite points.

Another great modern theory is that of elliptic modular functions, with its development, that of automorphic functions. In a letter to Borchardt ("Crelle," vol. lxxxiii. (1877)) Dedekind pointed out the importance of the function he calls the *Valenz*; essentially this is no other than the modular function $j(\omega)$, which enjoys the property that $j(\omega)=j(\omega^1)$ if, and only if, $\omega^1=(\alpha\omega+\beta)/(\gamma\omega+\delta)$ where α, β, γ, δ are real integers such that $\alpha\delta-\beta\gamma=1$. This introduction of j as fundamental, instead of Hermite's ϕ, ψ functions, marks an epoch in the theory; it should be noted, however, that H. J. S. Smith had practically reached similar results as early as 1865 (see his report on the Theory of Numbers, Arts. 125 ff.).

We now pass on to Dedekind's work in the theory of numbers. Gauss extended the theory so as to include complex integers $m+ni$, and proved that all the usual rules, especially that of the unique resolution of an integer into prime factors, still remained valid. Kummer investigated algebraic integers derived from the period-equations of cyclotomy, and was confronted by the vexatious fact that the theorem about prime factors broke down; thus we might have $\alpha\beta=\gamma\delta$ with α, β, γ, δ all integral, each irresolvable in the field considered (and in that sense prime), yet γ essentially differing from α, β by having a different norm. By the invention of ideal primes, Kummer overcame the difficulty, so far as these cyclotomic integers were concerned. His discoveries naturally suggested a definition of an algebraic integer in general, and the problem of defining its prime factors. Dedekind first gave a complete solution in supplement xi. of the third edition (1879) of Dirichlet's "Zahlentheorie"; this is undoubtedly one of the finest mathematical works that have ever been written, and although in the fourth edition (1894) the method is simplified, the original exposition should always be read, and in some ways is unsurpassed, not to say unsurpassable. Briefly, the author establishes the notions of corpus (or field), ideals and their bases, discriminants, including that of the field considered; he proves the general laws of divisibility for every field, and in particular shows how to factorise the real integral prime factors of the discriminant of the corpus—one of the main difficulties of the theory. Besides this, he discusses systems of units, the composition and equivalence of ideals, their connection with the theory of forms, and the problem of finding the number of non-equivalent classes for a given field. All these results are of the highest generality and importance; and every arithmetician, who wishes to advance the theory, must be familiar with them.

In conjunction with H. Weber, Dedekind published in "Crelle," vol. xcii. (1882), a long and important memoir on algebraic functions of one variable. The main feature is the discussion of "algebraic divisors," which play much the same part here as ideals do in an arithmetical field. They allow us to gain a precise conception of a "place" on a Riemann surface, and lead in a remarkably simple way to proofs of the invariance of the *deficiency* (*genre, Geschlecht*) of the surface, the Reimann-Roch theorem, and so on. Consideration of expansions in a variable t is reduced to a minimum, though (as pointed out by Weierstrass) it cannot be avoided altogether. The methods of this memoir have been developed by Hensel and Landsberg in their treatise on algebraic functions; it seems to us that they form a happy mean between merely heuristic methods and the very dry presentation of the Weierstrassian school.

Another subject on which Dedekind wrote some valuable notes is the theory of groups; however, this is not the place to give a list of his writings. It is to be hoped that they will be published in a collected form, as some of them are not easily accessible; they are not voluminous, and, so far as our experience goes, they are remarkably accurate, so there is no reason for delay. G. B. M.

NOTES.

A CONFERENCE convened by the president and council of the Royal Society was held at Burlington House on Wednesday, March 22, to consider the desirability of establishing a Conjoint Board of Scientific Societies for the purpose of organising scientific effort in this country. Delegates from the following societies attended to confer with the president and council of the Royal Society:—Royal Society of Edinburgh, Royal Society of Arts, Royal Anthropological Institute, Royal Astronomical Society, Royal College of Physicians, Royal College of Surgeons, Royal Geographical Society, Royal Institution, Institution of Civil Engineers, Institution of Electrical Engineers, Institution of Mechanical Engineers, Institution of Mining Engineers, Institution of Naval Architects, Institute of Chemistry, Society of Chemical Industry, British Association, Chemical Society, Geological Society, Linnean Society, London Mathematical Society, Physical Society, Physiological Society, Zoological Society. The following resolution was passed unanimously, and a committee was appointed to draft a scheme for giving effect to the resolution and to report thereon to a future meeting, viz.:—"This meeting considers that it is desirable to establish a Conjoint Board of Scientific Societies for the purpose of (1) promoting the co-operation of those interested in pure or applied science; (2) supplying a means by which the scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; (3) taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; (4) discussing scientific questions in which international co-operation seems advisable."—We are glad that the Royal Society has taken this step towards the organisation of scientific activities for the promotion of national welfare. The necessity for the unity of effort contemplated in the principles embodied in the foregoing resolution led to the establishment of the British Science Guild in 1905; and Sir Ronald Ross, in the *Times* of March 29, expresses the opinion that the business affairs of science would be better entrusted to such a separate body as the guild than to a board of scientific societies, the members of which are chiefly interested in the publication and discussion of scientific papers.

On February 23 the French Academy of Agriculture held its annual meeting. There is always a touch

of style and of charm in French men of science, and the meeting was made into a little festival. A bust of Pasteur was installed in the place of honour, a prize was decreed to M. Schloesing, that veteran of the Académie des Sciences, who is now in his ninety-second year, and a most admirable address was given by M. Gaston Bonnier. It is true that English men of science, likewise, are well able to instal busts, decree prizes, and give addresses. But France does it better, for she is not afraid, as we are, of magniloquent oratory. And M. Bonnier not only gave his audience an address, but also read them a poem, "A la gloire de Pasteur"—a poem which won the Grand Prix of the Académie Française last year, the work of M. Charles Richet, professor of medicine in Paris, a man honoured by all physiologists in France and over here. This noble poem is published, with M. Bonnier's address, in the *Revue Scientifique*, March 11–18. The reference to Lister is delightful:—

> Honneur à toi, Lister, qui, seul dans cette foule,
> T'opposant aux clameurs des savants et des sots,
> Pendant qu'un vain torrent de critiques s'écoule,
> En admirant Pasteur, sus dompter nos fléaux.

But the whole poem deserves study. Truly, a pleasant little festival of gratitude, goodwill, and reverence; and while these quiet men of science were celebrating in Paris the glory of Pasteur, the batteries of Verdun were thundering out the everlasting glory of France.

The *Times* and other London daily papers recently made reference to Dussaud's invention of the so-called "cold light" which, it was suggested, was being used for the searchlights mounted on Zeppelins. So far as we have been able to ascertain, the device rests on the plan of overrunning a metallic filament lamp at anything from 50 to 150 per cent. higher voltage than the normal. The candle-power of a filament lamp progresses approximately as the 3·6th power of the voltage, and the efficiency of an overrun lamp is high. The safety of the filament is secured by applying the current only momentarily, and the flicker of the light is avoided by employing a nest of lamps, which are lighted in succession by the use of a motor-driven rotary switch provided with the appropriate number of contacts. The British patent specification speaks of "low-voltage lamps" (less than 25 volts), which restriction may be conditioned by the length of time required to raise the filament to incandescence. The device has been applied to kinematograph lanterns, the interval between the excitation of two successive lamps being arranged to correspond with the interval between successive pictures.

An article on recent Zeppelins appears in the *Times* of March 25, under the name of Mr. George Prade. It appears to be the most trustworthy statement yet available, and is based on an examination of the remains of LZ. 77, brought down by French artillery near Révigny. Super-Zeppelins are dismissed as products of the imagination, and the latest Zeppelin proves to be a very natural outcome of the results of prior experience. LZ. 77 appears to have weighed 32 to 33 tons, and to have carried 1½ tons of bombs. Its defensive armament consisted of six machine-guns, used in pairs on the top and two cars, and nothing in the nature of cannon was found on the airship. From the dimensions, length 525ft. and diameter 55 ft., it appears unlikely that the highest speed attainable with the engines developing the full 900 to 1000 h.p. would exceed 65 m.p.h., a speed much below that of recent aeroplanes. It may be doubted whether the pointed tail now adopted is intended to reduce resistance, and the form is more probably due to considerations relating to manœuvring and control. The height of the airship at the beginning of its flight is said to be 6000 ft.; the burning of fuel on the outward journey, together with the discharge of bombs, would give 10,000 ft., the last 2000 of which would occur at a great rate. Germany is estimated to have about forty Zeppelins at the present time, and to be producing new ones at a rate of perhaps thirty-five per year. Most of the existing airships are used for patrolling and scouting over the North Sea, this being their legitimate offensive function.

A meeting was recently held in Manchester, under the presidency of the Lord Mayor, of engineers and others called together by the Council for the Organisation of British Engineering Industry, to hear an address by Mr. T. C. Elder, of the British Electrical and Allied Manufacturers' Association. It was pointed out that whilst we are now engaged in a deadly military struggle with Germany, we are also engaged in a scarcely less vital economic strife which is going on now, and will increase in intensity after the struggle of arms has ceased. The measures of defence mainly suggested were chiefly of a fiscal and preventive character such as one speaker suggested, namely, that of putting "a ring fence round Germany." So long, however, as our manufacturers choose to look for a remedy in purely fiscal changes, so long will they fail of any effective defence against German productive enterprise, for it is clear to any impartial inquirer that her industrial position is due to her lavish educational provision for all grades of education and to the encouragement given to pure and applied science more than to any other cause. Many important "key" industries are in her hands because of the perfection to which the products required have been brought. Amongst these, dye products stand pre-eminent with an annual importation of nearly two millions, of which 1,800,000*l*. come from Germany, vitally affecting an industry, that of textiles, valued at 200,000,000*l*., and employing about one and a half million people. The plain truth of the matter is, as a writer dealing with the history of "British Dyes, Ltd.," recently stated, "that the Germans held the coal-tar colour industry in their hands because they deserved it," and until we take like far-seeing educational measures, our triumph in this rivalry will not be gained.

We regret to learn of the death of Prof. O. Lignier, professor of botany in the University of Caen, and of distinguished eminence by his work in palæobotany.

The family of Lieut.-Col. C. Stonham, whose death was announced in Nature of February 24, has presented his collection of British birds to his old school, the King's School, Canterbury.

In the course of a review in last week's Nature, "G. B. M." referred to a report that the library of the Patent Office had been closed as a war economy. We are glad to be assured that this is not the case; and in the interests of those who find the library of value we hasten to announce that it will remain open as usual.

The *Lancet* announces that the annual oration of the Medical Society of London is to be given this year by Sir St. Clair Thomson, who has selected for his subject "Shakespeare and Medicine." The date has been fixed for Monday, May 1, so as to bring the oration into line with the official Shakespearean celebrations.

We are very glad to be able to record that Prof. Mark Baldwin, who was reported to have been lost by the torpedoing of the cross-Channel steamer *Sussex* on Friday last, is safe at Wimereux, with Mrs.

Baldwin. Their daughter has, however, been seriously injured, and is in hospital. Prof. Baldwin was on his way to Paris, after delivering the Herbert Spencer lecture at Oxford, summarised in last week's NATURE (p. 93).

THE *Times* correspondent in the Balkan Peninsula reports that the substitution of the Gregorian Calendar for the Julian or Eastern has been voted by the Bulgarian Chamber. He adds:—"The adoption of this change, which has been long delayed on account of the opposition of the Russian Heirarchy, is naturally a demonstration against Russia, and will be generally attributed to a desire to widen the chasm separating the two States."

AT the third annual general meeting of the Institution of Petroleum Technologists, held on March 22, Sir Boverton Redwood, Bart., retired from the presidency in conformity with the by-laws (after two years' tenure of that office), and was succeeded by Prof. J. Cadman. The vice-presidents and council for the ensuing year are:—*Vice-Presidents*: The Rt. Hon. Lord Cowdray of Midhurst, Sir Thomas H. Holland, and Sir Boverton Redwood, Bart. *Council*: A. C. Adams, H. Allen, Sir Robert Balfour, Bart., Capt. R. W. Barnett, H. Barringer, Dr. G. T. Beilby, E. R. Blundstone, A. Campbell, J. T. Cargill, Major A. Cooper-Key, E. H. Cunningham Craig, A. W. Eastlake, C. Greenway, T. C. Palmer, Dr. F. Mollwo Perkin, and R. Redwood.

THE Christiania correspondent of the *Morning Post* reports that Capt. Roald Amundsen, who traversed the north-west passage in the *Gjoa* and led the Norwegian Expedition to the South Pole, has resumed his preparations for an expedition to the North Pole, which were suspended on the outbreak of the war. A short time before that event the Storthing voted 12,000*l.* as a subscription towards the expenses of the enterprise, but having regard to the war, Capt. Amundsen did not accept the money. He thinks, however, that the time has now come to make arrangements to start next summer. He proposes to leave Point Barrow, North Alaska, and to drive with the ice over the polar basin.

MORE detailed accounts of the report of the South African Government Committee on the Rand earth-tremors have now reached this country. The shocks are described as consisting practically of a single sharp vibration, the sensation being similar to that produced by the fall of a heavy body on the ground. On the surface, the shocks were sometimes strong enough to open cracks in house walls. Underground, the effects were occasionally disastrous, causing loss of life and damage to the mines. Yet the distance to which the shocks were felt was small, only rarely amounting to as much as seven miles. This implies a slight depth of origin, and the conclusion at which the committee arrives scarcely admits of doubt that the shocks are due to mining operations and not to natural causes. The committee considers that the pillars left have not been strong enough to support the roof, and that their sudden crushing gives rise to the shocks. Some of the slighter tremors are attributed also to the fracture and settling of the overlying strata.

THE President of the Board of Trade has decided to appoint committees to consider the position of certain important British industries after the war, especially in relation to international competition, and to report what measures, if any, are necessary or desirable in order to safeguard that position. The following committees have accordingly been constituted:—For the iron, steel, and engineering industries: Sir Clarendon Hyde (chairman), Mr. A. Balfour, Sir Hugh Bell, Bart., Mr. A. J. Hobson, Sir Hallewell Rogers, and Mr. D. Vickers. For the shipping and shipbuilding industries:—Sir A. A. Booth, Bart. (chairman), Prof. W. S. Abell, Sir Archibald Denny, Bart., Sir Edward Hain, Capt. H. B. Hooper, Mr. J. Readhead, Mr. O. Sanderson. All communications relating to the above committees should be addressed to Mr. Percy Ashley, the Board of Trade, S.W. The constitution of a committee for the textile industries will be announced shortly.

WE record with much regret that 2nd Lieut. Kenneth R. Lewin, protozoologist to the Rothamsted Experimental Station, was killed in France on March 9. Mr. Lewin took the Natural Science Tripos at Cambridge, and, influenced by Prof. Sedgwick, chose protozoology as the special subject of his life-work. After his course at Cambridge, he spent some months at Munich under Prof. Hertwig, and at the Naples Biological Station. On his return he became assistant to Prof. Nuttall, and then in 1913 he was appointed protozoologist to the Rothamsted Experimental Station, where his work speedily justified the promise of his college days. His investigations were made in conjunction with C. H. Martin, who also lost his life in Flanders last May, and the combination proved most happy. The problem presented to Lewin at Rothamsted was to find out first of all whether there was a trophic protozoan fauna in the soil, and, secondly, what was its mode of life. He began with Martin's film method, the details of which he improved, and later introduced a bubbling method, both of which he used with considerable success on certain types of soil. The results are given in two papers published jointly with Martin, one in the Phil. Trans. for 1914, the other in the *Journal of Agricultural Science.* This last paper was finished just after the outbreak of the war. So soon as it was done, Lewin returned to Cambridge and joined the O.T. Corps, afterwards obtaining a commission in the 6th D.C.L.I. An able zoologist with abundant vigour of thought and freshness of outlook, and at the same time much kindliness and sympathy towards all with whom he had to deal, it is deplorable that the distinguished scientific career which was before Lewin has been abruptly ended by his death.

MR. SELOUS, in the *Zoologist* for February, continues his diary of ornithological observations made in Iceland during June and July, 1912. He has much that is worth recording to tell of the curious courtship displays of the red-necked phalarope, and incidentally of the habits of many other birds frequenting the same haunts. One is compelled, however, to hunt laboriously for these good things amid a mass of quite unnecessary detail. We further venture to think that Mr. Selous would have seen much more of the courtship displays of the birds he was more especially interested in if he had commenced his observations at daybreak, for it is at this time and onwards for the next hour or so that their greatest intensity is developed.

A VIVID insight into the habits of the waterhen, coot, redshank, ringed plover, and lapwing, especially during the reproductive period, is given by Miss E. L. Turner in *British Birds* for March. In a series of impressionist pictures, delightfully flippant, and illustrated with admirable photographs, Miss Turner describes the courtship displays of these birds and their desperate jealousies in regard to their territorial rights during the breeding season. The scene of her studies was the Mere in Holy Island, and here, between

March and June, she achieved some really useful work. The unneighbourly character of the waterhen has long been recognised, but few, probably, realise the pugnacity it displays when fighting for territory or when driving off trespassers when that estate has been won. The true character and the importance of this aggressiveness has only recently been realised, having been first clearly demonstrated in the case of the British warblers by Mr. H. Eliot Howard. Until then the battles between males had always been regarded as contests between rival males for the possession of females. Miss Turner's observations in this article entirely bear out the newer interpretation.

In the forest of Soigne, at the gates of Brussels, Belgium possesses two Government arboretums, arranged on the group system, planted with exotic trees under forest conditions. These were founded about twenty-five years ago, and, conditions being very similar to those which obtain in England, they afford useful object-lessons, possibly very little known, which should be studied by British foresters. Fortunately, these arboretums were visited by Mr. D. E. Hutchins, formerly principal forest officer in British East Africa, in the summer of 1913, and his account is published in the Transactions of the Royal Scottish Arboricultural Society, vol. xxx., pt. 1, of January, 1916. Among trees which will not grow in Belgium may be mentioned *Sequoia sempervirens* and many Japanese trees which require a heavy rainfall. Douglas fir is the fastest-growing conifer in both arboretums, and among the oaks *Quercus rubra* has given the best results. Details of the growth of the various trees, with girth measurements and age, are given in all cases.

Prof. A. Henry contributes an illustrated article on the black poplars to the Transactions of the Royal Scottish Arboricultural Society, vol. xxx., January, 1916. He deals especially with the wild European and east North American species and their various forms and hybrids. The American species *Populus deltoidea* bears cilia on the margins of the leaves, and glands on the base of the leaf in front, and the flowers have 40–60 stamens and 3–4 stigmas. In the European poplar *P. nigra* the leaf characters of the American plants are absent, and the stamens are only 12–25 and stigmas 2. It is remarkable that the European species, though well known to the pre-Linnæan British botanists, was named by Michaux from introduced species growing on the banks of the Hudson and in New York City. The Lombardy poplar is only a sport from this species, and originated probably as a single tree between 1700 and 1720 in Lombardy, and practically all the examples are males. The only known female Lombardy is at Kew, and its history is unknown. The numerous hybrid poplars are described in detail, and their value as timber trees is discussed. Some vigorous hybrids—*e.g., P. generosa*—have been produced by Prof. Henry.

Mr. Carlos Ameghino has contributed to *Physis* (vol. ii., No. 9, pp. 36–9) a useful French abstract of his important memoir on a femur of the extinct ungulate Toxodon, which seems to have been penetrated during life by an implement of quartzite, and suggests the great antiquity of man in the Argentine region of South America. The Toxodon is considered to be of a small species, older than the Pampean formation, perhaps even Pliocene, and the bone was found in a deposit at Miramar, which may well be of this age. The quartzite implement is actually embedded in the great trochanter of the femur, where the growth of bone has partly enveloped it.

Prof. R. A. Daly, of Harvard, has stated his views as to the "Origin of the iron ores of Kiruna" in a memoir issued by the Nordiska Bokhandel of Stockholm as part of the *Vetenskapliga och praktiska undersökningar i Lappland* (1915). The visit of many members of the International Geological Congress of 1910 to the magnetite mountain of Kiirunavaara, under the guidance of Herr Lundbohm, aroused wide interest in the theoretical questions connected with the massive band of ore. Prof. Daly expresses himself with caution, but he regards the porphyritic igneous rocks as originally intrusive in the form of a laccolite, the uptilting of their sheets being due to later earth-movement. The magnetite became separated, probably by gravitation, from the igneous magma, and even the small and often angular blocks of magnetite in the quartz-porphyry are held by the author to be local segregations, akin to the main ore body, and not inclusions.

On October 3, 1915, a great earthquake was recorded shortly after 7 a.m. at Eskdalemuir and other observatories in this country. The epicentre was estimated to lie in one of the western United States. It now appears that this earthquake must have been one which occurred in Pleasant Valley, Nevada, at 10.54 p.m. (Pacific standard time) on October 2, and is described by Mr. J. Claude Jones in the Bulletin of the Seismological Society of America (vol. v., 1915, pp. 190–205). If it had occurred in a populous district, the earthquake would have ranked as one of the destructive earthquakes of the world. It disturbed an area 800 miles long, from north to south, and 650 miles in width, an area which does not differ much in extent from that affected by the Californian earthquake of 1906. Pleasant Valley runs in a southerly direction from about 40 miles south of Winnemucca. On the east side, it is bounded by the southern half of the Sonoma Range, along the base of which, for a distance of 22 miles, Mr. Jones traced a fresh fault-scarp, nearly vertical, and varying in height from 5 to 15 ft. The movement along this fault, which caused the earthquake, was the latest of a series responsible for the elevation of this part of the Sonoma Range.

Messrs. Edward Stanford, Ltd., have just added two new maps (Nos. 16 and 17) to their series of war maps. No. 17 is a map of the British front in France and Flanders, and is on a scale of half an inch to a mile; it extends from Boesinghe beyond Ypres on the north to Bray-sur-Somme on the south, and is coloured on the layer system, contours being shown at 125 and 250 ft. It thus contains the whole of the 70 miles line of front now held by us. The other map (No. 16), also coloured on the layer system, embraces the whole of the troubled districts in the Balkan Peninsula, including the mouths of the Danube and Constantinople, Salonica, Belgrade, and Serajevo. The scale is 18 English miles to 1 in.

The relation between cirrus directions as observed in Melbourne and the approach of various storm systems affecting Victoria is the subject of Bulletin No. 10 of the Commonwealth Bureau of Meteorology. Mr. E. T. Quayle records the direction of movement of cirrus clouds in advance of the various types of cyclonic depressions which affect Victoria, and finds close correlations between these and the distance of the trough of the depression. Thus, in the case of the commonest type of depression in Victoria, the so-called Antarctic depression, observations indicate that cirrus movements to the south of west are associated with a trough more than 700 miles away, and north of west

with a trough fewer than 700 miles away. Further, the author contends that his results are of value in forecasting rain. Taking the normal cirrus direction as west, a departure of 8° to the north was associated with general rains, 4° to the south with partial rains, and 12° to the south with a failure in rain. Mr. Quayle contends his results show that cirrus movements can be used as guides in forecasting the weather, and gives some general rules in application to the weather of Melbourne.

THE usual method of cartographical representation of density of population based on the consideration of each census district as a whole has many drawbacks. Not only does it entail frequent sudden breaks in continuity when a district with a high degree of density adjoins one with a low, but it has the fatal objection of being founded on purely arbitrary political divisions. A new and far more scientific method has been worked out by Mr. B. C. Wallis, and described, with specimen maps of Hungary, in the *Geographical Journal* for March, 1916 (vol. xlvii., No. 3). Mr. Wallis has taken the average density for each commune, the smallest area for which there are returns, and, using these figures as "spot heights," applied the principles of contour lines. The result is a justification of the method. In like manner, Mr. Wallis has applied this method to illustrate the distribution of nationalities in Hungary, and has produced an instructive map, which is of far greater usefulness than the old-fashioned and rather meaningless chart in which the percentage of each nationality is given in figures of different colours in each commune. The paper goes on to deal with some of the results of the distribution which the map illustrates.

CALCULATING machines form the principal subject of a paper by M. Leonardo Torres y Quevedo in the *Revue générale des Sciences* (xxvi., 21), under the title, "Essais sur l'Automatique." It deals with the construction and principle of devices, mainly electrical, for performing arithmetical and other operations without human intervention. A possible cause of error, namely, the production of electric sparks, is considered, and a method of obviating this risk is suggested.

RESULTS of magnetical, meteorological, and seismological observations for the month of August, 1915, and the annual report for 1914, of the Royal Alfred Observatory, Mauritius, show that an exceedingly valuable series of results is being secured under the directorship of Mr. A. Walter. A table is given of the means and extremes of the principal meteorological elements for the year compared with previous results from about 1875. Other tables give the monthly departures from average of the various meteorological elements, also the mean hourly velocity of the wind for the eight five-year periods from 1876 to 1914, and other information of a meteorological, magnetical, and seismological character. During the visit of the German cruiser *Emden* to the station at Cocos Island the meteorological instruments were destroyed. Much valuable information is secured by the observatory staff from the logs of ships traversing the Indian Ocean, and by this means details are obtained relative to the formation and movement of cyclones over the Indian Ocean.

ON July 15, 1896, the Pacific coast of Japan was attacked by a tremendous ocean wave, the sea off the coast of Miyato rising and falling alternately. The second crest reached the maximum height, and the oscillation then decayed rapidly. The hypothesis that this disturbance was due to a sudden depression of the sea-bottom over a limited area forms the subject of a hydrodynamical investigation of the wave motion theoretically produced by such a disturbing cause. This theory, which assumes the sea-bottom to be of uniform depth and the depression to be circular, appears to give results according with those of observation to a reasonable degree of closeness. The times from the beginning of the earthquake to the first wave, the interval between the first and second, and the fact that the second is the highest, are results in which theoretical calculations accord fairly well with results of observation. The paper, which is by Keizó Sano and Kea Hasegama, is published in the Proceedings of the Tokyo Mathematico-Physical Society, viii., 7.

IN pamphlet No. 20 of *Mededeelingen en Verhandelingen* of the *Koninklyk Nederlandsch Meteorologisch Instituut* (Utrecht, 1915, pp. 24), P. H. Gallé discusses steamer routes from Durban and Cape Agulhas to various parts of the Dutch East Indies. This subject has recently attracted a certain amount of attention on account of the increase of shipping between these points, and since the paper was written Dutch East Indian passenger liners have started going round by the Cape instead of through the Suez Canal. The factors affecting a choice of routes are:—(1) The equatorial counter-current and other easterly currents near the equator; (2) the south equatorial current and the easterly drift south of lat. 35° S.; (3) the West Australian current; (4) the N.E. and S.W. monsoons; (5) the S.E. trade winds; (6) easterly winds south of lat. 30° S.; and (7) westerly winds S. of lat. 35° S. Various charts indicate a region round the Cocos Islands, between lat. 10° and 20° S. and between long. 90° and 105° E. as being more or less free from cyclones, but according to the author the existence of this region is doubtful, and requires further investigation. The publication is chiefly of nautical interest.

THE annual report of the director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for 1915 shows the large amount of work which has been done by the department both on land and at sea. We have referred as occasion has offered to the magnetic survey work at sea carried out on board the *Carnegie*, which last year devoted herself to the Pacific. The present report announces that the following land surveys have been completed:—Through Central Brazil from Rio de Janeiro to Para; interior of southern China and Mongolia; general magnetic survey of Australia; Australasian and West Pacific Islands; the Belgian Congo and Angola and the south-west coast of Africa. At Washington itself the new buildings have been brought into use, and a considerable amount of reconstruction and improvement of instruments has been accomplished, especially in relation to measurements of atmospheric electricity. Abstracts of thirteen papers which have been published by the staff during the year are appended to the report, which contains a record of work for the good of the world on which the Carnegie Institution may justly pride itself.

A PAPER on the Rangoon River Training Works, by Sir George Cunningham Buchanan, read before the Institution of Civil Engineers on March 21, contains some interesting details of an engineering undertaking of considerable importance. The Port of Rangoon, to-day the third port of the Indian Empire, is situated on the left bank of the river of the same name, which constitutes one of the deltaic mouths of the Irrawaddy, at a distance of about 28 miles from the sea. At this point, which also marks its junction with two other effluents, the stream assumes a very sinuous course, and, swinging round a bend in fro

of the town, has for a long time past produced very marked erosion of the right, or concave, bank, with corresponding accretion on the other. It was realised that unless this action could be checked the channel would ultimately be deflected away from the town and the existence of the port jeopardised. The remedial work consisted of a training wall, 13,000 ft. long, constructed of stone rubble laid on a brushwood mattress foundation, with a reinforced concrete superstructure finishing at high-water level of neap tides. The work was begun in 1910 and completed in the spring of 1914, at a total cost of 921,783*l*. The stone —a porphyritic diorite—was mainly obtained from quarries specially opened out on an uninhabited island, some 135 miles distant from Rangoon, situated in the open sea off the Tenasserim coast. The total quantity of stone used amounted to nearly 28 million cubic feet. The mattresses for the foundation absorbed $5\frac{1}{2}$ million bundles of brushwood from local jungles.

THE Institution of Electrical Engineers has issued a new edition of its rules for the electric wiring of buildings. They differ chiefly in points of detail from the code issued in 1911. One of the modifications relates to the arrangement of switches and fuses on installations connected to three-wire networks with earthed neutrals, to ensure that the connection to the neutral main shall not be interrupted before those to the outer conductors. Another calls for double-pole switches on all electric heaters rated above 1 kw. The rules are now adopted by fifty insurance companies.

MESSRS. W. HEFFER AND SONS, LTD., Cambridge, announce for early publication "Methods in Practical Petrology," by H. B. Milner and G. M. Part. The work is intended for petrological students and others who wish to make their own rock slices, and will contain chapters on the preparation of rock slices, examination of rock slices, microchemical methods (staining), and mounting of sands and crushed rock material, with an appendix on the preparation of stains.

A NEW monthly periodical entitled *Physiological Abstracts* is about to be issued by Messrs. H. K. Lewis and Co., Ltd., under the editorship of Prof. W. D. Halliburton. We understand that the term "physiological" is used in a wide sense, and that the journal will contain important papers in allied sciences which have physiological bearings; thus, abstracts will be given of papers in comparative physiology and biochemistry, as well as in physiology proper. It is not proposed to print original communications unless there be special reasons for so doing.

OUR ASTRONOMICAL COLUMN.

THE PLANET VENUS.—The nearest approach to the Pleiades will occur about 6 p.m. on Tuesday, April 4. Venus will then appear approximately $2\frac{1}{2}°$ distant from Alcyone, the brightest star of the cluster.

NEW LINES IN THE SPECTRUM OF SILICON.—Prof. A. Fowler, in a paper communicated to the Royal Astronomical Society (*Monthly Notices*, lxxvi., pp. 196–7), gives the following lines in the spark spectrum of silicon, most of them observed and identified for the first time. λλ 5740·2 (int. = 10), 4829·4 (4), 4820·1 (3), 4813·7 (2), 3590·5, and 3487·1. All have been found to show the laboratory behaviour characteristic of Lockyer's Group IV. lines (*i.e.* brought out by the strongest condensed discharges), and the four less refrangible also appear in the Harvard reduction of the spectrum of β Crucis (B1, Cru.), which also shows the previously known lines of Group IV., λλ 4089 and 4116·5.

DEFINITIVE ORBIT OF COMET 1802.—First observed by Pons on August 26, 1802, this comet was observed 140 times during a period of forty-one days, describing heliocentrically an arc of 46°. On the basis of the orbit calculated by Olbers from his own observations K. Lundmark has derived the following elements by the method of Schonfeld:—T = 1802·69; epoch, 1900; $\omega = 21° 51·7'$; ☋ = 310° 54·6′; $i = 56° 59·9'$; log *q*, 0·0391. Perturbations have not been calculated, as the comet was observed for so short a period, and, moreover, a graphical examination showed that the comet in its path through the solar system had nowhere approached the major planets. Identity with comet 1909 I. would give a period of 106·734 years, and the next earlier apparition would be 1695, but the orbit of the comet of that year is not known with the requisite accuracy to establish identity.

A NEW METHOD FOR THE DETERMINATION OF LATITUDE.—The solution of the outstanding problems connected with the variation of latitude is now being sought in variety of methods as contrasted with the uniformity of the international latitude service. In this connection attention is merited by a method proposed and successfully employed by Dr. G. Zappa (*Atti R. Accademia dei Lincei*, vol. iii., p. 69, 1916). The new method is a modification of Struve's, in which high altitude stars are observed in the prime vertical, and the essential improvement consists in the employment of pairs of stars, one E. the other W., chosen so that the observation of both can be made in a short interval of time. It is claimed to afford results comparable with those given by the Horrebow-Talcott method, and may thus possibly serve to clear up the mystery of the Kimura term. The mean error of a latitude deduced from nine pairs of stars (Boss, P.G.C.) is ±0·10″, whilst the latitude of the Observatory of Capodimonte has been determined with a mean error of ±0·35″, but the relevant number of observations is not stated. The "Carpe" premium has been awarded to Dr. Zappa for his memoir.

THE PLANE OF THE SOLAR MOTION.—A further paper by Prof. von S. Oppenheim on the subject of stellar motions appears in *Astronomische Nachrichten*, No. 4830, and nominally concerns the plane of the solar motion. Shortly after Kobold's well-known memoir on this subject was published, Harzer showed that the method reduced to the solution of a cubic equation giving the axes of what Prof. Oppenheim now terms the "momenten-ellipsoid." Although the Bessel-Kobold method gave a good value for the right ascension it failed to determine the declination of the apex, and no further attention appears to have been given to the Harzer ellipsoid. Prof. Oppenheim has now found the possible significance of the remaining axes by an application to the case of the geocentric motions of the minor planets. In a recent paper (see NATURE, October 21, p. 209) he employed the Bessel-Kobold method to investigate the plane of the solar motion, and incidentally found that the Charlier sectors were divided into two groups, about half giving the normal value for the Ω, whilst for the others the value was found to be 360° − Ω. as though direct and retrograde stellar motions had been discriminated. The two groups have now been treated separately, and it is stated that the momenten-ellipsoids are enantiomorphous. One axis of each is, of course, directed towards the solar apex; by analogy with the minor planets it appears that the second axis points to the pole of the plane of the solar motion, whilst the third is directed to the ideal centre of the stellar orbital movements.

A NEW VOLCANO IN THE KIVU COUNTRY.

A JOURNEY in the eastern part of the Belgian Congo and in German East Africa is described in the *Geographical Journal* for January (vol. xlvii., No. 1) by Sir Alfred Sharpe, who was accompanied by the Hon. Mountstuart Elphinstone. The journey, which was made in 1912–13, included a visit to the little-known regions west of Lake Kivu, around the Lukulu river, but the travellers' most remarkable experience was the sight of a volcanic action in the region north of Lake Kivu. From the southern end of the lake a dull-red glare in the night sky became stronger as they went north, and there were dense black clouds by day in the same direction. From Bobandana, at the north-west corner of the lake, a splendid view was obtained of the erupting volcano seven miles away.

The floor of the rift valley north of Lake Kivu is crossed by the volcanic belt of the Mufumbiro Mountains, containing many cones of all sizes. At the time of Sir Alfred Sharpe's visit two of these were active: Nyamlagira, which was throwing out vast volumes of black cloud, with occasional showers of mud, and the newly-opened one, christened Katarusi by the Belgian officials, which was in more active eruption. In eleven days Katarusi had built a cone 600 ft. in height with a crater of 600 yards in diameter, arising from an ancient field of lava, no doubt derived from Nyamlagira, and long covered with open savanna.

Photo] [*The Hon. M. W. Elphinstone.*

FIG. 1.—North-west corner of lake, almost boiling. From the *Geographical Journal.*

Sir Alfred Sharpe describes a broad, swift river of lava flowing into the Kabino inlet of Lake Kivu, three miles from the volcano. The water in that part of the lake was heated to boiling point. The prevailing wind, from the east, was carrying clouds of steam, smoke, and ashes to the west. A large bay in the northern part of the Kabino inlet was filled with lava, and the natives were fleeing from the country after the destruction of their villages and crops. At least one canoe load of natives, overcome by steam and black clouds, was carried into boiling water and sank. Thousands of dead fish were floating in the northern end of Lake Kivu. Twelves miles from the volcano the water was too hot to bathe in. Later on the travellers passed over some of the country devastated by the volcano. For miles the land was black, with no green leaf or blade to be seen, and many dead birds and small mammals were found, evidently killed by the showers of volcanic material. Hundreds of natives were killed. The eruption was audible at Beni, 140 miles away to the north, and at Bukoba, on the Victoria Nyanza, 190 miles east, while ashes fell heavily for two days at Walikali, in the Congo forest, 100 miles to the west

Photo] [*The Hon. M. W. Elphinstone.*

FIG. 2.—Lava filling Kabino Inlet, Lake Kivu. From the *Geographical Journal.*

BRITISH LABORATORY GLASS-WARE.

AT the outbreak of the war the manufacture of glass for chemical and physical purposes was practically a monopoly of "the Central Powers," and, since most British apparatus dealers replenish their stocks in the summer, the supply available in August, 1914, was very limited. Realising the gravity of the situation, the British Science Guild and the Association of Public School Science Masters approached the leading educational authorities asking them to undertake to buy only glass of British manufacture during the war and for three years after it ended; the response was very satisfactory, and more than 75 per cent. of the schools represented on the Headmasters' Conference gave the required promise.

While this action was being taken the majority of the firms of apparatus dealers formed "The British Laboratory Ware Association," which enlarged some of the existing glass houses, and has placed some very satisfactory material on the market. Messrs. Baird and Tatlock decided, however, to open new glass houses of their own at Walthamstow, instead of joining the association; these houses are now in full working order, and the firm has just issued a catalogue. The glass is of two qualities: (1) a hard, boro-silicate glass of practically the same composition as Jena, from which they manufacture flasks, beakers, etc.; and (2) a soda glass, which is principally used for drawing tubing. We have used apparatus made from each material, and find it thoroughly satisfactory in every respect; their "Duroglass" beakers and flasks stand sudden changes of temperature fully as well as did those made abroad, whilst their shape compares very favourably with the early attempts of the British glass-blowers; their soda glass tubing is easy to work, as it shows no sign of devitrifying in the flame, a property which will be much appreciated by those who experimented with British glass tubing fifteen months ago.

Unfortunately the prices charged by both the British Laboratory Ware Association and Messrs. Baird and Tatlock are considerably higher than those charged for Bohemian glass before the war; and if the trade is to remain in this country it will be necessary for a substantial reduction to be made when conditions are once more normal. Without entering upon the political aspect of the case, we sincerely trust some means will be devised for preventing our works and laboratories again becoming dependent upon foreign supplies.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

WORK OF THE ADVISORY COUNCIL.

IN order that the Advisory Council may be in a position to do justice to the branches of industry concerned in proposed researches of great importance which have been submitted to the council by institutions and individuals, it has decided to appoint standing committees of experts. Strong committees in mining and metallurgy have already been constituted, consisting both of scientific men and of leaders of the industries concerned. The Mining Committee will have two sections, dealing respectively with the mining of non-metals and the mining of metals. Sir William Garforth, the well-known coalowner, has accepted the chairmanship of the committee and of the non-metals section; and Mr. Edgar Taylor, of the firm of John Taylor and Sons, owners and managers of metalliferous mines in various parts of the world, has accepted the chairmanship of the metals section. The Metallurgy Committee will also have two sections, dealing in this case with ferrous and non-ferrous metals respectively. Sir Gerald Muntz, Bart., of Muntz Metal Co., Ltd., Birmingham, has accepted the chairmanship of the committee and of the non-ferrous section; and Sir Robert Hadfield, of Hadfield's, Ltd., Sheffield, has accepted the chairmanship of the ferrous section. The Advisory Council hopes at an early date to constitute a similar committee for engineering.

Up to the present the council has been engaged in work which is mainly initiatory and preparatory in character. For example, in order that investigations already in progress should so far as possible be carried on in spite of the war, scientific and professional societies were invited to submit applications for aid to continue researches for which the necessary staff and equipment were obtainable. Grants have already been made, or will shortly be made, to the Institution of Mechanical Engineers (hardness tests and the properties and composition of alloys), to the Institution of Electrical Engineers (heating of buried cables and the properties of insulating oils), to the Institute of Chemistry (laboratory glass and optical glass), to the Institution of Mining and Metallurgy (methods of extracting tin and tungsten), to the Institute of Metals (corrosion of non-ferrous metals), to the Institution of Gas Engineers (refractory materials), to the Manchester Association of Engineers (tool steel experiments), and to the National Physical Laboratory (optical glass). Other proposals of the same type are still under consideration. Timely and valuable results have been quite recently obtained from the researches carried out by Prof. Herbert Jackson under the auspices of the Institute of Chemistry and from the researches carried out at the National Physical Laboratory by Dr. Rosenhain. The Advisory Council has also recommended a grant in aid of an important new research into the manufacture of hard porcelain, especially for domestic purposes. This has been undertaken by the governing body of the Stoke-on-Trent Central School of Science and Technology, in conjunction with the Staffordshire Potteries Manufacturers' Association, with a view to the establishment of the manufacture of hard porcelain in this country.

Particulars have been obtained of the research work not only of the scientific and professional societies, but also of the universities and higher technical schools, with a view to the establishment of a register of research. The possibility of proceeding to collect in the near future information under seal of confidence as to the research work of particular firms is also being considered.

The training of an adequate supply of research workers will be an important branch of the Advisory Council's work, and the steps to be taken for that purpose will require much careful thought. It is impossible to announce definitive plans during the war, but the Advisory Council is so much alive to the urgency of the matter that it has thought it necessary to take immediate interim action, and has, therefore, made recommendations which, if adopted, will, it is believed, secure that all that is practicable in existing circumstances shall be done.

CHEMISTRY AND NATIONAL PROSPERITY.[1]

THE remark of a French *savant* that this was a country where the apothecaries call themselves chemists, might, as one of the consequences of the war, become less pointed than formerly. But it would be an even greater consequence if in future ours ceased to be a country where money was synonymous with

[1] Abstract of an address to the Aberdeen Chamber of Commerce on February 8, by Prof. F. Soddy, F.R.S.

wealth. As regards the real wealth of the world, its matter and its energy, as man had found it so, largely, had he left it, until the beginning of last century. Eternally moralising and philosophising about himself, he left little behind him but a vast legacy of morbid introspection for the "education" of his children. Ignorant of the simplest principles which control absolutely his life from the cradle to the grave, he strove to entail upon his successors in perpetuity the conclusions of his preposterous self-examinations. The time had come when, as the result of a disastrous war, this entail had been broken. Henceforth it would be known that science had in its control the major physical factors of human existence. Already the attempt had been made to foist upon science the responsibility of the war. But science was neither the destroyer nor the upbuilder; it was the docile slave of its human masters. The use made of it depended upon whether they were awake to their position with regard to the external realities of nature, or whether they were still trying to compromise with the old mixed mythologies. After the war, whatever its outcome, science and its application could retrieve every disaster, and make good even the present seemingly irreparable destruction.

A change had come over the relations of man to matter and energy. No longer between these two, as between a steam-hammer and an anvil, he now had a hand on the valve. And if they examined the hand they would find that it was the hand of the chemist.

Just as the control of money was put into the hands of a properly authenticated banker, let them see to the hand in the control of their wealth. Let it not be the hand of the lawyer-politician, or of a hypnotised dreamer "born in the menagerie," as Mr. H. G. Wells had expressed it, whose intellectual faculties were in thrall to the past, nor even of the medical man, as, now too long, the exclusive public representative of science. Let it be in the hands of honest and well-trained chemists and similar representatives of the other physical sciences, and they would be surprised what unimagined wealth was rolling by unheeded, as Niagara used to do, but rarely as picturesquely and inoffensively. Let them not be frightened by those who would have them believe that science—the knowledge and control of the world outside and independent of themselves—was a monstrous materialism. Such people merely disclosed their ignorance of science, and all that it meant for humanity.

A chemist if he were genuine was rarely worldly-wise. To him secrecy and individualism were the antithesis of the spirit of science. He might be able to put on half a sheet of notepaper that which would keep a whole class in the community in prosperity for a generation. But he would be lucky if until the end he kept out of the poor-house, and still more lucky if in his old age he could still call any of his discoveries his own. But the real discovering type of chemist was a very rare bird, and it was scarcely necessary to say he was not the type specially catered for by university curricula. From a business point of view he was a thoroughly bad investment. He paid no more fees than his numerous fellows, his training was preposterously expensive, if he was to know his subject and not know about it, and, worst of all, when he was hatched, no one could be sure whether he was a swan or a goose. Obviously with universities, financially managed by business men, the good staple lines of chemical students are far more attractive. They can be turned out in large numbers relatively cheaply, their fees aggregate to a considerable sum and bear an appreciable proportion to the cost of their education, and their numbers speak for themselves.

But a chemist, gauging the relative chemical value to the nation of all this teaching, would rate it in the inverse ratio to that in which it would be regarded if numbers or revenue accruing to the university were the criterion. You need the small army of professionally trained students to keep the existing machine going. But a machine that just keeps its own cumbrous self going has no right to the title of a prime-mover. As much and more do you need the pioneers, those who are to stand erect for the first time and know their way, where all before have been befogged, in whose solitary footsteps the army *can follow.* A university that does not give of the best it can afford for these is oblivious to the more difficult and more repaying side of its dual function.

HIGH EXPLOSIVES AND THE CENTRAL NERVOUS SYSTEM.

MAJOR F. W. MOTT, who recently delivered the Lettsomian Lectures[1] to the Medical Society of London upon "The Effects of High Explosives on the Central Nervous System," pointed out that a new epoch in the medical history of war had arisen in consequence of trench warfare and the employment of projectiles containing large quantities of high explosives. In particular, he discussed the causation of death without visible injury, resulting from the detonation of large quantities of high explosives, *e.g.* trinitrotoluene contained in shells, as well as other projectiles, and mines. The central nervous system contained in the closed cranio-spinal cavity is suspended in a water-jacket of cerebro-spinal fluid, which, under ordinary conditions of shock, effectually protects the delicate nervous structures from commotion; and the large quantity of this fluid at the base of the skull serves particularly as a water-cushion protecting the vital centres of the medulla oblongata from the effects of concussion.

Major Mott discussed the possibility of the aerial force generated by detonation of 50–200 lb. of trinitrotoluene being so great as to be transmitted through the fluid to these vital centres, and cause death by instant arrest of the cardiac and respiratory centres. Considerable attention was given to the observations of a French civil engineer, M. Arnoux, who found that the effects of the explosion of a large shell upon an aneroid barometer were such that decompression experiments to produce similar effects on the barometer indicated that a pressure of 10,000 kilos per square metre must have been generated by the explosion. M. Arnoux inferred from this that the bursting of a large shell might cause such an intense atmospheric decompression as to liberate enough bubbles of air and CO_2 in the blood to prove fatal by the blocking of multiple small vessels (embolism). In support of this hypothesis, it was pointed out that multiple embolism is the cause of Caisson disease. Lord Sydenham expressed the opinion to Major Mott that the explosive force might cause death by the sudden pressure on the thorax and abdomen, arresting the action of the heart and lungs.

The possibility was also discussed of the production of noxious gases, *e.g.* CO, which would deoxygenate the blood by combining with the hæmoglobin, and thus cause the sudden death of groups of men who have been found in trenches and closed spaces without visible signs of injury and in the last attitude of life. In explanation thereof, he suggested that the muscles of fatigued men suddenly poisoned by inhalation of carbon monoxide in large quantities might pass rapidly

[1] The Lettsomian Lectures on "The Effects of High Explosives upon the Central Nervous System," delivered before the Medical Society of London by Dr. Fred W. Mott, F.R.S., Major, R.A.M.C. (T.), 4th London General Hospital. *Lancet*, February 12, 26, March 11, 1916.

into *rigor mortis*. In support of this hypothesis it may be mentioned that Major Mott received through Lord Sydenham information from the secretary of the War Trench Committee to the effect that imperfect detonation of 50–100 lb. of trinitrotoluene would produce sufficient carbon monoxide to cause poisoning.

In support of the opinion that carbon monoxide poisoning may account for some of the symptoms and the fatal termination of cases of "shell shock with burial," and without visible external energy, Major Mott showed photographs and photomicrographs of the brains of cases of carbon monoxide poisoning, and demonstrated the fact that the punctate multiple hæmorrhages found throughout the white matter of the brain corresponded with the appearances presented by the brain of a soldier who had been buried by the explosion of a shell. How long he had been buried was not known, as he was brought in comatose to the field ambulance station and remained so until death forty-eight hours later. Throughout this brain, especially in the white matter (as the photographs and photomicrographs demonstrated), there were multiple punctate hæmorrhages. There was no visible external injury to account for this condition of the brain, but, of course, it might have been the result of concussion by a sandbag; the lecturer adduced reasons against this assumption, and said the question whether carbon monoxide poisoning was a factor in the production of severe symptoms and fatal termination in "shell shock" could only be settled by examination of the blood of these cases. The lecturer thought that this would be worth doing, for he had seen numerous instances of shell shock with burial showing no visible injury, in which there was a complete loss of recollection and recognition, and from which the patients only slowly recovered. He narrated similar cases of profound loss of memory occurring as a result of carbon monoxide poisoning previous to the war.

Interesting photomicrographs of the spinal cord of a man who lived forty-eight hours after shell shock with burial were shown. The man retained consciousness to the end, but was paralysed in all four extremities; the intercostal muscles were also paralysed. The man was evacuated five minutes after the shell burst; therefore there was no time for him to be poisoned by carbon monoxide. Examination of the spinal column showed no visible sign of injury, but there were most extraordinary changes in the fourth and fifth segments of the spinal cord—notably hæmorrhage in the grey matter, sieve-like vacuolation of the fibres of the posterior column, and of one antero-lateral column; another striking feature was enormous swelling of many of the axis cylinders. The phrenic nucleus which innervates the diaphragm was destroyed with the exception of some of the cells in the third segment; these exhibited chromatolysis indicative of exhaustion. Sudden death would have been the result if the lesion had been half an inch higher, as the whole "nucleus diaphragmaticus" would have been destroyed by the spinal concussion, and respiration would have instantly ceased. How the spinal concussion was effected could not be ascertained; it was most probably due to a sandbag hurled from the parapet, for this man was partially buried. Still, it is difficult even then to account for the limitation of the lesion to an inch of the spinal cord except by transmission of the force to the cerebrospinal fluid in which the spinal cord is suspended. The changes in the spinal cord were exactly similar to those described by Col. Gordon Holmes [2] as a result of concussion of the spinal cord caused by bullet wounds of the spinal column without penetration of the enclosing membranes.

Regarding the sieve-like vacuolation of the myelin fibres, and the enormously swollen axis cylinders, unlike that produced by ordinary fracture dislocation, it is of interest to note the opinion of Prof. Leonard Hill, who, in a letter to the lecturer, suggested that the shock may have been so great as to kill the axoplasm, for "a water pressure of between 300 and 400 atmospheres kills all protoplasm (excepting deep-sea fishes). Water enters into the muscle and swells it and turns it opaque. There are curious fractures produced in the muscle fibre. The myelin of nerve fibres is broken up by the water entering into these. In the case of a high-velocity bullet striking the spine, it seems possible that the cerebro-spinal fluid beneath the struck part may be instantly compressed and act as a solid body transmitting the blow to the cord. There cannot be time for the fluid to be displaced. There is, anyway, a water-pressure limit beyond which protoplasmic activity is destroyed, and I imagine bullets must produce this pressure, but I very much doubt whether air waves produced by shell bursts can reach to such pressures as 300–400 atmospheres."

It is quite possible, therefore, that a sandbag hurled against the neck could cause spinal concussion similar to that of a bullet wound, but without producing visible injury.

Major Mott then directed attention to the fact that while a large number of these patients were of a neurotic or of a neuropathic disposition, yet the strongest nervous system would eventually break down under the stress of continuous exposure to shell fire and trench warfare.

The varying groups of signs and symptoms indicative of loss of function or disorder of functions of the central nervous system arising from exposure to forces generated by the detonation of high explosives are classed under the term "shell shock." In a larger number of cases, although exhibiting no visible injury, shell shock is accompanied by "burial." The signs and symptoms, with the exception of the profound effects on consciousness and memory, accord in the main with those of the two common types of functional neurosis—neurasthenia and hysteria.

From the point of view of compensation or pension the War Office authorities very properly regard "shell shock" as a definite injury, although there may be no visible sign of it. This fact is of considerable importance, for, as in the case of pension or compensation for traumatic neurasthenia under the Employers' Liability Act, the notion of never recovering may become a *fixed idea*. The detection of conscious fraud is not easy in many cases of "shell shock" in which recovery might reasonably have been expected, for it is difficult in many cases to differentiate malingering from a functional neurosis due to a fixed idea. The first point is to be sure of your diagnosis that the disease is altogether functional, and being satisfied thereof to avoid all forms of suggestion of the possibility of non-recovery. A very great difficulty in the complete investigation of these cases arises from the fact that few or no notes, as a general rule, accompany the patient; one has therefore to rely upon the statements made by the patient himself, or perchance by a comrade, if he has no recollection of the events that happened. Most of the cases of "shell shock," however, are able to give satisfactory information of the events that preceded the shock; they even tell you they can call to mind the sound of the shell coming and see it in the mind's eye before it exploded; then there is a blank in the memory of variable duration. In some of the more severe cases, especially where there has been burial or physical concussion by a stone

[2] "Spinal Injuries of Warfare." Being the Goulstonian Lectures delivered before the Royal College of Physicians of London by Lt.-Col. Gordon Holmes. *Brit. Med. Journal*, November 27, December 4 and 15, 1915.

or a sandbag, or by falling heavily on the ground after being blown up in the air, there is a more or less complete retrograde amnesia of variable length of time. In a case of simple "shell shock" it is impossible to say whether the patient was unconscious during the whole period of time of which he has lost all recollection of the events that happened, or whether during the whole or a part of the time he was conscious, but owing to the "commotio cerebri" the chain of perceptual experiences was not fixed.

In the majority of cases "shell shock" affects only the higher cortical centres; in severe cases the vital centres, as in apoplexy, alone continue to function, and the patient is in a dazed condition, and he may automatically perform complex sensori-motor purposive actions of which he has no recollection whatever. Several cases of this kind have come under notice, one of the most trustworthy being a history obtained from an officer. His company had dug themselves in in a wood; he went out into the road to see if a convoy was coming, when a large shell burst near him. It was about two o'clock in the morning and quite dark; about 4.30 a.m. it was quite light, and he found himself being helped off a horse by two women who came out of a farm-house. He had no recollection of anything that happened between the bursting of the shell and this incident.

The frequency with which these cases of shell shock suffer from terrifying dreams at night and in the half-waking state points to the conclusion that a psychic trauma is exercising a powerful influence on the mind by the thoughts reverting to the terrifying experiences they have gone through, and their continuous influence on the subconscious mind may account partially for the terrified or vacant look of depression on the face, the cold blue hands, feeble pulse and respiration, sweats and tremors, some or all of which signs of fear the severer cases manifest. As these dreams cease to disturb sleep, so these manifestations of fear tend to pass off and give place to the sweet unconscious quiet of the mind. Occasionally during the waking state contemplation of the horrors seen provokes hallucinations or illusions which may lead to motor delirium or insane conduct. A number of striking illustrative cases were given.

Speech defects are a common symptom of "shell shock." Of these mutism is the most common; it may be associated with deafness. Unable to laugh or cough sonorously, to whistle, or to whisper, indeed, to produce any audible sound, mutes are able nevertheless to express their silent thoughts by writing. The cause of the muteness is due to loss of power of phonation. Major Mott discussed this subject very fully in a paper read before the Society of English Singers.[3] Besides mutism and aphonia, stuttering and stammering are not uncommon conditions. There is no difference between the mutism and aphonia met with in "shell shock" and that of hysteria; the manner in which it disappears is similar; even a trivial circumstance, in which attention is taken off its guard and the mute is surprised by an emotional shock, may cause the patient suddenly to speak.

A very interesting case was narrated of a grenadier who, when admitted, was blind, deaf, and mute; he was, however, extremely sensitive to skin impressions; indeed, it seemed as if the mind focused attention on the perceptual avenue which had not been functionally dissociated by the shock. His sight was restored to him quite suddenly, and he was then able to communicate his silent thoughts by writing. His power of recognition was good, but his recollection was a blank for the whole period of time he had been in France, and he could give no information regarding the circumstances which led to the condition he was in. A few days later he became very emotional, and suddenly recovered his hearing and speech.

Although mutes are unable to speak voluntarily, yet under the influence of terrifying dreams they often call out in their sleep. One man had been shouting in his sleep and was told this the next morning by a comrade; he was so surprised that he said, "I don't believe it."

Various functional paralyses are common, and an injury often determines the seat of the paralysis by suggestion; thus a man may be blown up and bruised on his hip or shoulder, and a fixed idea is engendered that the limb is paralysed. Functional paralysis of the lower extremities in consequence of injury of the back is a common condition; likewise various disorders of gait and station, tremors, coarse and fine, tics, and choreiform movements are other manifestations of motor functional disorders. Hyperæsthesia, or increased sensibility of the skin to stimuli, and anæsthesia are of frequent occurrence. One of the commonest and most troublesome symptoms is hyperacusis, or sensitiveness to noises; and when the Zeppelin raid occurred many serious relapses took place. It would take too long to detail the manifold symptoms that may arise in consequence of these functional neuroses.

Major Mott does not employ hypnosis or psycho-analysis; he considers these modes of treatment unnecessary, as he has cured numbers of cases by making a careful examination of the patient, and then assuring the paralysed, the tremulous, the mutes, and others that there is no organic disease, and that they will certainly recover. An atmosphere of cure is necessary; therefore when a patient with functional paralysis comes with crutches or sticks, the first thing he does is to order them to be taken away, for they are not required. Many men who had been paralysed weeks and months have thus been cured in a few hours or a few days. Massage and electricity, and all other treatment which suggests a disease, he deprecates. He strongly advocates diversion of the mind from the recollection of the late terrifying experiences by music, games, and amusements of all kinds, and he appealed to the charitable public to provide such for the new Maudsley Hospital of the London County Council, Denmark Hill, which has been recently taken over by the War Office for the treatment of 200 of such cases as those to which he referred.

[3] "The Psychic Mechanism of the Voice in Relation to the Emotions." *Brit. Med. Journal*, December 15, 1915.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Special Board for Biology and Geology have made the following grants from the Gordon Wigan Fund:—30*l.* to the Department of Geology towards meeting the deficit in the working of the department; 40*l.* to the Department of Botany for assistance to the curator of the herbarium in his work on the British flora; 30*l.* to Prof. Punnett, in order that the Botanic Garden Syndicate may continue to offer special facilities for plant-breeding experiments; 5*l.* to the curator in entomology for the care and development of the collections of insects; 15*l.* to Prof. Gardner for the provision of special lectures in parasitology in connection with the diagnosis of disease.

The council of the Teachers' Guild has arranged for a conference on educational reform, to be held on Saturday, April 8. Specialists in various grades of education—university, technical, secondary, and

primary—have been invited, and also well-known leaders in industry and commerce. The chair will be taken by Sir Henry Miers, and the draft prepared to be submitted to the conference for approval suggests the following subjects to be dealt with by committees of experts:—(*a*) Reforms in administration, including co-ordination of various grades of education; (*b*) the relation of technical colleges, university courses, and research scholarships to manufactures; (*c*) training of women for professional, technical, and commercial occupations, and for domestic life; (*d*) improvements in the curricula of schools and in instructional materials and methods, so as to make them more purposeful and adaptable to after life; (*e*) extension of educational facilities to all juveniles after fourteen; (*f*) training and status of teachers, and research in education; (*g*) medical service and physical education; (*h*) character training and training for leisure; (*i*) reform of examinations, also of methods of selecting candidates for public appointments, and for promotion within educational institutions.

ARRANGEMENTS have been made for the usual short summer course at the Oxford School of Geography for teachers and others interested in geography; but the meeting will not take place this year unless a prescribed minimum number of applications is received by the middle of April. If this number is reached an introductory lecture will be given on the afternoon of August 3. There will be two lectures and at least one period of practical work or an excursion each day. There will be short courses on selected topics of physical, historical, and political geography (especially geographical problems affecting the war and the British Empire), on transport and trade routes, on the teaching of geography, and on the Oxford district. The fee will be 3*l*. for the whole course; a number of students will be accepted for lectures only at a fee of 2*l*. for the course, or of 2*s*. for single lectures. Further particulars will be issued as early as possible in May. Names cannot be sent in too soon, addressed to the Vacation Course Secretary, School of Geography, 40 Broad Street, Oxford, to whom, also, all requests for further information should be sent.

THE paper on "Part-time Education for Boys and Girls," which Mr. J. H. Reynolds read at the Conference of Educational Associations last January, has been circulated in pamphlet form. The paper is rich in impressive facts, which demand the earnest consideration of British statesmen. Mr. Reynolds points out there are 71,000 half-time children, chiefly in the textile districts of the north, to-day. There are some 193,000 children who have entirely left school on reaching the age of thirteen. The number of young people in England and Wales between the ages of fourteen and seventeen was, according to the last census, 2,030,195, to which must be added nearly 200,000 who had left school and entered into employment at thirteen, giving a total of at least $2\frac{1}{4}$ millions. About 436,000 of these were receiving some sort of education, leaving a net total of upwards of 1,800,000 young people who had ceased to continue their education at day or evening schools. There are in England and Wales 236,000 children below fourteen working half-time or full-time, and 200,000 more working for wages while attending school for full-time. As Mr. Reynolds urges, there is an imperative necessity for a compulsory system of continued education for all children leaving the elementary school at fourteen, who enter into employment, and it might extend from six to eight hours per week throughout the greater part of the year, meaning annually some 270 hours of systematic instruction extending over at least three years.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 23.—Sir J. J. Thomson, president, in the chair.—G. **Green**: The main crests of ship waves, and on waves in deep water due to the motion of submerged bodies. The fundamental problem of ship waves is to determine the wave disturbance produced by an arbitrary pressure system advancing over the free surface. The present paper gives a general method of obtaining the solution of the moving pressure problem in the form of an integral, and proceeds to the evaluation of the integral in some particular cases of ship waves.—E. H. **Nichols**: Investigation of atmospheric electrical variations at sunrise and sunset. Observations were made for a period of fifteen minutes before and fifteen minutes after both sunrise and sunset, using the Wilson compensating gold-leaf electroscope for conductivity and earth-air current, and two Ebert electrometers for measuring the positive and negative electric charges. The results show a decided uniform decrease in the value of electrical quantities throughout the sunset period, but the solar effect at sunrise is not at all pronounced. The potential curves for Kew Observatory were analysed for the years 1912 and 1914 for the 30-minute period at sunrise and sunset, and monthly means obtained for 5-minute intervals, these being corrected for diurnal variation. There is a general increase in the potential at both sunrise and sunset, being more noticeable in the winter months, but there is no evidence of any sudden change. It is possible that the electrical variations observed may be of assistance in elucidating the problems of wireless transmission.

PARIS.

Academy of Sciences, March 13.—M. Camille Jordan in the chair.—H. **Douvillé**: A family of Ammonites, the Desmoceratideæ: an attempt at a rational classification. The value and subordination of characters.—M. de la Vallée-Poussin was elected a correspondant for the section of geometry in the place of Félix Klein. —J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1915. Observations were possible on eighty-five days, of which fifty-one were consecutive, from July 24 to September 12.—Arnaud **Denjoy**: Differentiation and its inverse.—Grace Chisholm **Young**: Derived numbers of a function.—Maurice **Le Pen** and Jean **Villey**: The measurement of the power of motors.—C. **Dauzère**: The crystallisation of phenyl ether.—E. **Briner**: The mechanism of reactions in *aqua regia*. A study of the reaction $HNO_3+3HCl=NOCl+Cl_2+2H_2O$, which is shown to be reversible. The system was proved to be monovariant, three phases and two independent components.—Carl **Störmer**: The altitude of the aurora borealis observed from Bossekop (Norway) during the spring of the year 1913. A large number of simultaneous photographs of the aurora were taken from the extremities of a base line 27·5 kilometres long, leading to 2500 determinations of the height. The results are given, both in graphical and tabular form. The heights vary from 86 to 180 kilometres, with a maximum frequency at 105 to 106 kilometres. —Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint Genis Laval) during the third quarter of 1915.—F. **Jadin** and A. **Astruc**: The manganese in some springs of the Pyrenees range. There is a certain relation between the amounts of manganese and total mineral matter in a water. Ferruginous waters usually contain a high proportion of manganese. It was noted that although sodium sulphide waters contain extremely minute proportions of manganese, yet the algæ growing round these springs contain this element in relatively high pro-

portions.—H. **Bouygues**: The tissues at the summit of the Phanerogam stem.—Lucien **Daniel**: The specific variations in the chemistry and structure provoked by grafting the tomato and the cabbage.—O. **Laurent**: The metallic suture in complicated fractures of the femur and humerus. Of the various methods used, wiring with one or two thick silver wires has proved the most satisfactory, details being given of the application of this treatment to several cases of fracture.—Jules **Amar**: Apparatus for prothesis of the upper limbs. Detailed description of two forms of mechanical arms.—R. **Ledoux-Lebard** and A. **Dauvillier**: Theoretical and experimental researches on the bases of the quantitave determination of the X-rays in radiotherapy.

BOOKS RECEIVED.

Rambles in the Vaudese Alps. By F. S. Salisbury. Pp. x+154. (London: J. M. Dent and Sons, Ltd.) 2*s*. 6*d*. net.

Department of the Interior. Weather Bureau. Annual Report of the Weather Bureau for the Year 1913. Part iii. Pp. 331. (Manila: Bureau of Printing.)

With Scott: the Silver Lining. By Dr. G. Taylor. Pp. xvi+464. (London: Smith, Elder and Co.) 18*s*. net.

Mathematical Papers for Admission to the Royal Military Academy and the Royal Military College for the Years 1906–15. (London: Macmillan and Co., Ltd.) 6*s*.

Macmillan's Geographical Exercise Books. Key to II., Europe, with questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*. net.

Factories and Great Industries. By F. A. Farrar. Pp. 90. (Cambridge: At the University Press.) 1*s*. 6*d*.

Trade and Commerce. By A. J. Dicks. Pp. 94. (Cambridge: At the University Press.) 1*s*. 6*d*.

Ships, Shipping, and Fishing. By G. F. Bosworth. Pp. 86. (Cambridge: At the University Press.) 1*s*. 6*d*.

Icones Plantarum Formosanarum. By B. Hayata. Vol. v. Pp. vi+358+xvii plates. (Taihoku: Government of Formosa.)

Colour: a Handbook of the Theory of Colour. By G. H. Hurst. Second edition, revised by H. B. Stocks. Pp. vii+160. (London: Scott, Greenwood and Son.) 7*s*. 6*d*. net.

Stanford's War Maps, Nos. 16 and 17. (London: E. Stanford, Ltd.) 5*s*. and 3*s*.

DIARY OF SOCIETIES.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—Skull of Ichthyosauras, Studied in Serial Sections: Prof. W. J. Sollas.—The Relation of Excised Muscle to Acids, Salts and Bases: Dorothy J. Lloyd.—The Endemic Flora of Ceylon, with Reference to Geographical Distribution and Evolution in General. A Correction: J. C. Willis.

CHILD STUDY SOCIETY, at 6.—The Child Delinquent: C. M. Chapman.

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 5.30.—The Spectra of Hydrogen and Helium: Prof. A. Fowler.

SATURDAY, APRIL 1.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

MONDAY, APRIL 3.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

ROYAL GEOGRAPHICAL SOCIETY at 8.30.—A Year's Travel in New Caledonia: C. H. Compton.

ROYAL SOCIETY OF ARTS, at 4.30.—Surveying: Past and Present: E. A. Reeves.

SOCIETY OF ENGINEERS, at 5.30.—Modern Coal and Coke Handling Machinery, as used in the Manufacture of Gas: J. E. Lister.

VICTORIA INSTITUTE, at 4.30.—The Influence of German Philosophy in bringing about the Great War: Prof D. S. Margoliouth.

TUESDAY, APRIL 4.

ROYAL INSTITUTION, at 3.—Modern Horticulture—Growing Time and Seed Time (Internal Rhythm): Prof. F. Keeble.

ZOOLOGICAL SOCIETY, at 5.30.—Living Cæcilians from South America: Prof. J. P. Hill.—(1) Specimens of the Perciform Fish, *Tilapia nilotica*, with Increased Number of Anal Spines; (2) The Lizards allied to *Lacerta muralis*: G. A. Boulenger.—Some Fresh-water Entomostraca from Ceylon: R. Gurney.—Notes on the Sitatunga or Marsh-Antelope of the Sesse Islands: Major R. Meinertzhagen.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The Rangoon River-Training Works: Sir G. C. Buchanan.—The Present Conditions of Arterial Drainage in some English Rivers: R. F. Grantham.

RÖNTGEN SOCIETY, at 8.15.—A Chronograph Constructed to Work with the Electroscope: P. J. Neate.—The Enclosed Tungsten Arc as a Source of Ultra Violet Light: B. H. Morphy and S. R. Mullard.—Experiments with a Coolidge Tube: E. Schall.—A New Modification of the Ionisation Method of Measuring X-Rays: H. E. Donnithorne.

WEDNESDAY, APRIL 5.

GEOLOGICAL SOCIETY, at 5.30.

ENTOMOLOGIAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—Painting by Dipping, Spraying, and other Mechanical Means: A. S. Jennings.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Alkalimetric Estimation of Certain Bivalent Metals in the Form of Tertiary Phosphates: Dr. W. R. Schoeller and A. R. Powell.—Note on a Specimen of Russian Oak: P. A. Ellis Richards.—The Estimation of Potassium in Presence of Other Substances: A. H. Bennett.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.

ROYAL SOCIETY OF ARTS, at 4.30.—The Work of the Imperial Institute for India: Prof. W. R. Dunstan.

LINNEAN SOCIETY, at 5.—On Five New Species of Edwardsia, Quatr.: Prof. G. C. Bourne.—A New Species of Enteropneusta from the Abrolhos Islands: Prof. W. J. Dakin.—The Southern Elements of the British Flora: Dr. O. Stapf.

FARADAY SOCIETY, at 8.—The Making of a Big Gun: Dr. W. Rosenhain.

FRIDAY, APRIL 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Notes on the Corallian of the Oxford District: M. Odling.—The Glacial Geology of the Hudson Bay Basin: J. B. Tyrrell.

SATURDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

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THURSDAY, APRIL 6, 1916.

HEREDITY AND CHROMOSOMES.

The Mechanism of Mendelian Heredity. By Prof. T. H. Morgan, A. H. Sturtevant, H. J. Muller, and C. B. Bridges. Pp. xiii+262. (London: Constable and Co., Ltd., 1915.) Price 12s. net.

THIS latest book of Prof. Morgan and his collaborators should be sure of a welcome from a wide circle of readers. In his preface Prof. Morgan deplores a tendency to regard heredity as a subject for specialists only, and states expressly that the present volume has been written for the biologist at large as well as for those who are more actively engaged in these studies. He has produced a book which should present no difficulties to anyone with the elements of a biological training, while at the same time it sets forth clearly and within reasonable compass the latest deductions and speculations of genetic research.

Prof. Morgan's book is avowedly an argument in favour of what is known as the chromosome theory of heredity. He points out that the mechanism revealed in the process of the maturation of the germ cells is also a mechanism which fulfils the requirements of the mode of distribution of Mendelian factors. A further argument is provided by the fact that in certain insects two kinds of sperms, differing in the number of the chromosomes which they contain, are associated respectively with the formation of a male and a female individual, and this argument was greatly strengthened when the discovery of the heredity of sex-linked characters provided independent evidence that the difference of sex could be expressed in terms of Mendelian factors.

As the result of a remarkable series of experiments with the pomace fly (*Drosophila ampelophila*) Morgan and his collaborators are able to add a striking piece of evidence in favour of the chromosome theory. In the course of these experiments more than one hundred characters of various kinds were shown to exhibit Mendelian inheritance, but the chief point of interest lies in the fact that they fall into four groups. The members of any given group exhibit linked inheritance with regard to one another, but are transmitted quite independently of the members of the other three groups. The importance of this point becomes evident when it is stated that the number of chromosomes in the pomace fly is four. If the chromosome theory is true and if the number of chromosomes is less than the number of factors exhibiting Mendelian heredity, it is clear that the factors must exist in groups corresponding to the number of the chromosomes. The large number of workable factors in Drosophila, coupled with the small number of chromosomes, has rendered possible an exhaustive test of this point such as is at present out of the question for any other species of animal or plant. The result clearly bears out the chromosome theory, and it is further strengthened by the fact that the members of only one of the four groups of characters show sex-linked inheritance, these being presumably those borne by the chromosome that also bears the sex-determinant.

There is, however, a complication which Prof. Morgan deals with in a most ingenious manner. When a cross is made between an individual containing two factors, A and B, lying in the same chromosome pair and another individual whose corresponding chromosomes contain the allelomorphs a and b, then in all subsequent generations proceeding from the $AB \times ab$ the two factors A and B should always hang together; in other words, there should be complete linkage between them. This, however, is not so, but in F_2 there appear a small proportion of individuals which may be represented as Ab, together with a corresponding proportion of the form aB; that is to say, the linkage is generally incomplete. To get over this difficulty Prof. Morgan suggests an explanation based on the observations of Jannsens that at certain stages of meiosis the homologous chromosomes belonging to a given pair twist round one another, and supposes that in a certain proportion of cases the chromosomes break on separation, so that both members of the resulting pair contain a portion of each of the two original chromosomes. This conception of "crossing-over," which is clearly explained and illustrated, involves the supposition that every factor has a definite locus in the chromosome in which it occurs, and Morgan claims that if the values of the crossing-over for A and B and also for B and C have been experimentally determined it is possible to predict the value of the crossing-over for A and C. Indeed, he has been able to construct a map of the four chromosomes of Drosophila showing the positions thus deduced of many of the factors.

The development of the chromosome theory in its present form is clearly incompatible with the presence and absence theory of factors as usually accepted; for unless each member of a pair of homologous chromosomes contains the same number of corresponding factors arranged in the same sequence the "crossing-over" could not occur in an orderly manner. Morgan points out that several cases now known are open to the simple interpretation that three factors are involved, any two of which are allelomorphic to one another. In Drosophila, for example, red and eosin eye form a simple pair, as also do eosin and white. Nevertheless, red and white also give a simple Mendelian result, no eosins making their appearance in F_2. These systems of multiple allelomorphs, which are not necessarily confined to three members, open up problems of great interest, to which the reader will find a chapter of the book devoted.

Though Prof. Morgan has succeeded in stating a strong case for the chromosome theory, there are nevertheless some gaps in the argument. We do not, for instance, know at present whether Drosophila shows the peculiar twisting of the homologous chromosomes round one another, such as was described by Jannsens in Batracoseps. The existence of such twisting is, of course, essen-

tial to the "crossing-over" explanation of the linkage of characters in heredity, and it is to be hoped that the cytologist will be able to decide the point one way or the other. Another phenomenon which requires clearing up is the absence of any "crossing-over" in the male for any character whatever, though the number and arrangement of the chromosomes in the two sexes are apparently identical. It is, of course, not impossible that what now appears to be a weak point might turn out to be a strong one if the cytologist could show that the behaviour of the chromosomes during the maturation divisions differed in the two sexes.

There are other objections to the chromosome theory which would require too much space to set out in detail, but whether the theory advocated by Prof. Morgan prove to be well founded or not, there can be no doubt that he has given us a most interesting and stimulating book. Not only does it give a clear and well-illustrated account of one of the most important groups of facts relating to heredity yet elucidated by the experimental method, but at the same time it offers the most successful attempt so far made to relate these facts to our knowledge of cellular anatomy. Together with the author we hope sincerely that it may be widely read outside the circle of professed students of heredity, and especially that it may be digested by those whose particular province is the minute structure of the cell.

THE TECHNOLOGY OF SULPHUR AND SULPHUR COMPOUNDS.

Manuals of Chemical Technology. V. Sulphuric Acid and Sulphur Products. By Dr. G. Martin and Major J. L. Foucar. Pp. viii + 77. (London: Crosby Lockwood and Son, 1916.) Price 7*s.* 6*d.* net.

A MELANCHOLY circumstance attaches to this book, which to a large extent disarms criticism. Before the section on sulphuric acid, for which Major Foucar, a former assistant manager of the Beckton Gas Works, was responsible, was ready for the press, war broke out, and Major Foucar was killed when leading his men into action. It devolved, therefore, on Dr. Geoffrey Martin, the editor of the series, to put together the material which had been collected, and at the same time to extend the scope of the volume.

The result is a book of some seventy pages—a space wholly inadequate to deal properly with the important subject with which it professes to deal. It is divided into four chapters, treating, respectively, of the sulphur industry, sulphuric acid, the manufacture of sulphur dioxide, and of certain other sulphur compounds, viz., carbon disulphide, sodium thiosulphate, and hyposulphite and sulphuretted hydrogen. The total amount of space given to these subjects is about sixty-five pages, the rest of the book, exclusive of the short preface and indexes, being made up of tables of weights and measures and comparisons of thermometer and hydrometer scales of the conventional type. Each chapter consists of short, disconnected notes on features of interest rather than of systematic accounts of the several industries. It is not very obvious what class of readers it is intended to serve. The student may gain from it a superficial knowledge of the technology of sulphur and of such of its compounds as are mentioned, but the actual manufacturer will find its information far too slight and "scrappy" to be of practical service. The language of the preface would seem to imply that the person aimed at is that ubiquitous individual known as the general reader. But if this is so we fear that person will gain a somewhat confused idea of its purport, for, small as is the amount of information conveyed, a glance through the pages of the book shows that it obviously presupposes some previous knowledge of the subject.

The account of the sulphur industry, constituting chapter i., will serve to illustrate what we mean. The whole chapter occupies five pages, of which half is given to a meagre description of the sources and mode of extraction of natural sulphur; about a page is given to a still more meagre account of the Chance-Claus method of sulphur recovery, the so-called thiogen process of treating smelter-smoke, and the Burkheiser and Feld methods of obtaining sulphur from sulphuretted hydrogen in coal-gas purification, whilst the remainder is concerned with the properties and uses of sulphur. The reference to the Sicilian industry and the allusion to the "calcarone" method convey no meaning to the uninitiated or any information to those who are initiated. The account of the Gill kiln and of the method of its working is so slight as to be practically valueless. The Frasch process of winning Louisiana sulphur is one of the most striking achievements of modern technology. It constitutes indeed one of the romances of applied science. Although Dr. Martin's method of treatment seems to disallow anything in the nature of descriptive writing, we think it would have added greatly to the interest and value of his book if he had given a fuller account of it. It is still not so generally known in this country as it ought to be, in spite of the fact that, as he truly states, it dominates the world's sulphur market.

Our general impression of this book is one of disappointment as a wholly inadequate treatment of a vastly important subject.

HOMER AND HISTORY.

Homer and History. By Dr. Walter Leaf. Pp. xvi + 375. (London: Macmillan and Co., Ltd., 1915.) Price 12*s.* net.

THE researches of Dr. Leaf have opened a new phase in the discussion of the Homeric problem. His first task is to discard the interpretations which have hitherto held the field. Until the publication of Wolf's "Prolegomena" the unity of the Epic was, as a matter of course, accepted. We were then invited to believe that the Iliad at least was a collection of lays welded into a single whole by some skilful editor. With the study of comparative philology came the

theory that the gods of Homer were manifestations of nature powers adapted to the local geography and the traditional history. This was followed in more recent times by the suggestion that the Iliad represents a reflex of combats fought, not in the Troad, but of tribal battles in Asia Minor between Eubœan-Bœotian colonists and Locrians or South Thessalians, or between Locrians and Bœotians on the Greek mainland.

Such speculations Dr. Leaf has little difficulty in confuting. He has now carried out an exhaustive survey of the text mainly on the basis of geography, and from this inquiry startling results emerge. In his last book on the subject he confined himself mainly to the Trojan side of the question. He proved that the Catalogue of the Trojan forces was a historical document of the highest value. Following Thucydides in his pregnant remark that wars in ancient as well as in modern times were based on trade rivalry, he made it at least highly probable that the war of Troy represented an attempt by the Achæan Greeks to gain possession of a great commercial *entrepôt* controlling the trade routes to the Black Sea and the hinterland of Asia Minor. The war was therefore a historical event, fought, not by faded survivals of nature deities, but by living soldiers and their generals.

The second important document in the Iliad is the Catalogue of the Greek ships, which is now found to stand in a very different position from that of Troy. It is full of discrepancies, such, for instance, as the fact that the Bœotians who figure largely in it were still in Thessaly in the time of the Great War. Besides this, the unsuitability of Aulis as a rendezvous for a fleet acting against Troy, and the impossibility of reconciling the domains of the Achæan princes with geographical facts, are now clearly demonstrated. The document, in short, was an attempt by a later hand to make its contents correspond with an altered condition of Greece.

This fruitful survey of Homeric geography and Greek tradition makes it possible to link the world of Homer with Gnossos and Mycenæ as they have been revealed to us by the excavations of Sir A. Evans and Schliemann, and the review of the historical and geographical situation which forms the introduction to this fascinating work is perhaps its most interesting feature.

We have no space to deal with the new light which Dr. Leaf has thrown on the problem of the Odyssey. He shows clearly that while the eastern Ægean was familiar to the Achæans, the west was a land of mystery, the home of a series of folk-tales, and he follows Dr. Dörpfield in his remarkable demonstration that the modern Thiaki is not the Ithaca of Odysseus, whose home was Leucas.

We have said enough to show the importance of Dr. Leaf's work. The book is a course of lectures intended to be delivered at the North-western University, Evanston, Illinois, a project which fell through on the outbreak of the war. They are now published by the courtesy of the Norman Wait Harris Lecture Committee. To use Dr. Leaf's words: "It may at least serve as a protest, faint and feeble enough, against the extinction of intellectual interest in the flood of barbarous materialism which has been let loose upon Europe." It is much more than this, a statement of the problem defined with logical precision and grace of style, which commend it not only to the trained scholar, but to all who are interested in one of the most vital questions of literature.

OUR BOOKSHELF.

A Manual of Soil Physics. By Prof. P. B. Barker and Prof. H. J. Young. Pp. vi+101. (London: Ginn and Co., 1915.) Price 3*s*.

Profs. Barker and Young have done well to collect the laboratory exercises which for the past ten years have been in use in the College of Agriculture of the University of Nebraska. In this region, where soil physics is so important, one may feel reasonably certain that survival for ten years is a sound test of value, and therefore teachers who are trying to introduce the subject into their courses will welcome the book.

All agricultural courses are modified by their surroundings. Nebraska is fortunate in possessing considerable areas of loess soil well provided with all the elements of fertility, but apt to suffer from drought at critical times. There is, however, sufficient rainfall to supply the needs of the plant if it is properly husbanded, and this is done by maintaining a fine layer of earth on the surface of the soil to act as a non-conductor and protect the bulk of the soil from the sun's rays. The study of the water relationships of soil forms a great part of soil physics, and in one form or another comes into a large proportion of the exercises here.

The authors have modestly had the book turned out in the form of a biflex binder notebook, so that loose pages can be taken out. This makes it difficult to handle, and it deserves something better. We hope that in later editions it will appear in proper book form so that it can be kept for permanent use. E. J. R.

The Journal of the Institute of Metals. Vol. xiv. Edited by G. S. Scott. Pp. ix+289. (London: Institute of Metals, 1915.) Price 21*s*. net.

This volume contains the papers which were read at the autumn meeting of the Institute of Metals in 1915, an account of which has already appeared in the columns of Nature, together with the discussion and written communications. So far as these papers are concerned, the chief place in technical importance must certainly be given to that by Mr. Parker on specifications for alloys for high-speed superheated steam turbine blading, which drew an important contribution from the president, Sir Henry Oram, the engineer-in-chief of the Navy. One of the special merits of this paper is that it makes a point of stating what are the chief requirements in modern specifications

of such alloys, and thus gives scientific workers definite problems of first-rate technical importance to work out. Prof. Edwards's paper on metallic crystal twinning by direct mechanical strain is illustrated by some very fine photomicrographs, which will repay detailed study, and prove that, in the case of tin, at any rate, twins are formed by mechanical strain.

The outstanding feature of the volume, however, is the text of the May lecture delivered before the Institute by Sir Joseph Thomson on the conduction of electricity through metals, in which he enunciated a new theory and directed attention to the remarkable results on super-conductivity obtained by Kamerlingh Onnes, of which there is no sign at the temperature of liquid hydrogen, but which are fully displayed at that of liquid helium. H. C. H. C.

Memoirs of the Wistar Institute of Anatomy and Biology, No. 6. The Rat: Reference Tables and Data for the Albino Rat (Mus norvegicus albinus) *and the Norway Rat* (Mus norvegicus). Compiled and edited by H. H. Donaldson. Pp. v+278. (Philadelphia: Wistar Institute, 1915.) Price 3.00 dollars.

The white rat, like the frog, is one of that select little group known as laboratory animals. For the study of problems connected with mammalian physiology it offers conveniences which in most cases place it beyond competition. After a brief introduction on the classification and early records of the common rats, the greater part of the book is devoted to the white rat, by which is understood the albino variety of the Norway rat (*Mus norvegicus*).

Following some short chapters on the biology, anatomy, and physiology of this animal, the bulk of the work is taken up by statistical tables dealing with the growth of the body and of its various organs in relation to it and to one another, a subject in which the author has conducted research for some years past. The general results of the growth records are also illustrated by a series of graphs by means of which the reader can at once obtain the general drift of the figures. A few pages are devoted to the wild Norway rat, for which far fewer data have been collected than for its pink-eyed relative, and the work concludes with a bibliography of more than fifty pages. A most useful feature of the book is the list of references arranged under headings at the end of each chapter. By means of these and of the bibliography at the end the student can at once ascertain what has been written on, for example, the anatomy of the urogenital system or the physiology of respiration in the white rat. Indeed, we think that this part of the work would bear some amplification. Under "Reproduction," for instance, no mention is made of Marshall's "Physiology of Reproduction," in which work occur other references not given here. Some omissions there are doubtless bound to be, but in this guide to the white rat the author has produced a valuable work of reference which should find a place in every physiological laboratory.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Science versus Classics.

In "Musings without Method"—which might with equal alliteration be termed "Ravings without Reason"—the editor of *Blackwood* gives in the March number his views on the claim of science to occupy a more prominent position in general education than has hitherto been allotted to her. He calls this claim "a ferocious attack on the humanities," an evidence of "unbalanced minds" devoid of "the sense of humour and proportion." He gratuitously assumes that men of science desire "to kill all other learning than their own," and asserts that for all men there is a need of verbal expression "which is most easily satisfied by the study of Greek and Latin." He endeavours to pour scorn on the usefulness of scientific knowledge by the story —probably apocryphal—of a "commercial house in the East" which sent to Cambridge for a chemist, and when a chemist was forwarded to them, promptly returned him on the ground that although there was nothing wrong with him as a chemist, he had no knowledge of the world! One wonders what has become of "Maga's" "sense of humour"? Clearly the "commercial house in the East" did not want a chemist! Had they asked for what they really wanted they would have been sent a classical don; who doubtless would have proved more than a match for the heathen Chinee, which was probably the problem to be tackled!

It is essentially the cause of Oxford and Cambridge which our knight of the pen comes forward to champion—at least, it is what he conceives to be the cause of Oxford and Cambridge. But why should Oxford and Cambridge furnish an exception? They might, it is true, from their more ancient standing, claim to give a lead to the others, but it should surely be the aim of all the universities to provide the best system of education which the needs of the country require.

The question is: What is the best system? We others believe that it is to be found in the introduction of the study of natural science into the upbringing of everyone, whatever his ultimate aim in life may be. The prime object of education is, or should be, the attainment of a knowledge of ourselves and our surroundings: this knowledge can only be obtained through the study of natural science. That other branches of learning—mathematics, philosophy, history, language, and literature—may help, is not contested, but the basis of education in an age in which all our prosperity, present and prospective, depends upon proficiency in science must be scientific. If he who runs cannot read as much as this, he is either purblind or hopelessly slow of understanding!

We need not go outside the pages of "Maga" to prove the inadequacy of the classics. Of what is this Cabinet composed which the editor has denounced in unmeasured terms from month to month as patterns of imbecility, hesitation, and vacillation, unable to see beyond the ends of their noses, incompetent to manage any department of State? Are not the ranks of the "gallant twenty-two" (now twenty-three) recruited almost exclusively from the institutions on the system of education of which "Maga" sets so high a value? Is not the Prime Minister, against whom particularly the editorial fulminations of "Maga" have so often been directed, himself a notable example of

classical attainments? Far be it from scientific men to belittle these or any other accomplishments—philosophical, literary, or artistic. Our contention is that—along with the more advanced study of the natural sciences—these other branches of learning should be treated as subjects of special education: that they ought not to dominate the general education of the country. So far from having any wish to kill all other learning, we desire to promote *all* learning, but that desire does not prevent us from thinking that training in science will have to take the place in schools which is now occupied by Greek and Latin.

I am aware that our opponents may retort we have no right to assume that persons who have had training in science as an integral part of their education are more competent to manage the affairs of the nation or to carry on business or industrial operations than those who do not possess this advantage. We possess, however, an example of the influence of scientific training on efficiency in one of the largest of our public departments—the Navy. This is admitted, even, I believe, by "Maga," to be the best organised of those departments; it is certainly the one in which the public places the most confidence. But the men upon whom this efficiency depends are distinguished from those of all other public Services in the fact that their education is, from the beginning, purely scientific. They have had no opportunity for the acquisition of that knowledge of the classics which "Maga" appears to consider necessary for the making of men; yet even the boys of the Navy have again and again demonstrated by their actions that the scientific training which they have received has not prevented them from showing of what stuff they are made.

Nor has "Maga" the right to assume that it is only the classical members of our ancient universities who have come forward so splendidly in this crisis of our national life. For, side by side with those of their classical fellows, "stand imperishable upon the roll of honour" the names of hundreds of science students who have—whether "from their despised studies" or not I cannot say—also "learned and taught the habit of command," and many of whom have, alas! also made the supreme sacrifice. But to anyone with a "sense of proportion," it must be obvious that this can have nothing to do with the question at issue. For in showing their readiness to give their lives for their country the members of the universities are doing no more than is being done by millions of their fellow-subjects at home and abroad.

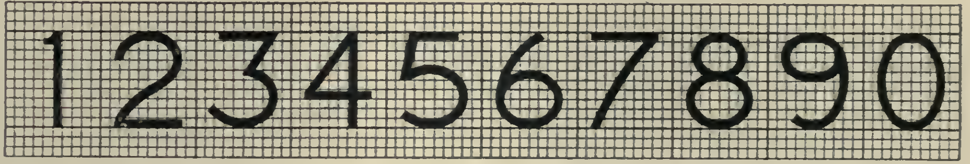
E. A. Schäfer.

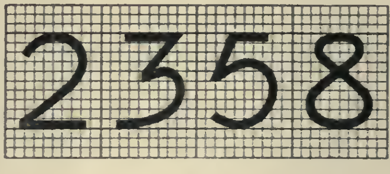
Numerals for Scales and Punches.

Seeing that excellently designed numerals are common on the scales of instruments, and bad styles are rare, I have been surprised at the interest which has been taken by engineers and others in the proposed numerals which were illustrated in Nature of February 24. I have adopted some of the suggestions which I have received in the revised set here illustrated. My intention eight years ago was to produce designs suitable for the scales of measuring instruments and for the dials of engine counters and electric supply meters, where the numerals appear through holes. Most of the suggestions which I have received since my paper appeared in the Journal of the Institution of Electrical Engineers relate to numerals punched on metal.

There are four classes of numeral characters: (1) For writing, including ordinary script, formal writing, inscriptions moulded in metal or cut in stone; (2) for typography; (3) for scales; and (4) for punches. Script demands legibility first, but gives considerable scope for caligraphy. In formal writing these requirements are reversed, and for inscriptions they carry equal weight. Typography makes certain intricate and subtle exactions for the purpose of producing balance and apparent uniformity of the characters. Such refinements do not seem to be required in the case of scales and punches. Scales often have to be read in a bad light, and, as I have said in my paper, elegance of shape is not to be disregarded altogether, but wherever necessary it must be sacrificed to legibility and to special restrictions in uniformity of size and thickness of line.

Punches for stamping numerals on metal make two additional demands on the designer. The first is that a character when inverted shall not be mistaken for another; the second is that if the impression is imperfect it shall do its best to be legible. The first case





consists essentially of the relation of the 6 to the 9, and it is so difficult to make a difference, that other numerals must lend their help. The 1 therefore should have a small serif, and there should be a marked difference between the upper and the lower part of the 8. I propose to retain my original 6, and I offer a 9 with a tail curling up a little to the left, but not enough to cause confusion with 8 or 0. In these numerals the thickness of the line is $7\frac{1}{2}$ per cent. of the height.

The 2 in the present set is a compromise between the swan-breasted one of the first set, and the acute angled type. I have tried to improve the 3 by adding one unit to the length of the top bar, but this has the drawback that if the lower 6/10ths is lost there may be a confusion with 7. The tail of the 3 is turned up higher than that of the 5 or 9. The 4, 6, 7, and 0 remain as before. For the sake of appearance the down stroke of the 5 slopes 1 in 10, instead of 1 in 20. Good impressions of the upper 4/10ths of these numerals should be legible. If the lower halves only appear, the difference between 3 and 5 is but slight, and there is no difference between the lower half of the 6 and of the 8. But if the lower 6/10ths are visible, I think that each numeral is legible. If 4/7ths of the breadth are lost on either side the remaining 3/7ths are legible.

I have shown these numerals to a friend, who said, "They are quite clear but quite beastly," and he pointed out that the limitations do not altogether preclude beauty of form. He directed my attention to certain good models, and I have based on these a 2, 3, 5, and 8. The 8 has the advantage that the lower half differs from that of 6.

I shall be glad to receive any further suggestions.

I have a few copies of my paper, and will send one to anybody who has not access to the Journal of the Institution of Electrical Engineers, and who is specially interested in the subject. A. P. Trotter.

Athenæum Club, Pall Mall, London.

International Latin.

I have always shared the regret of your correspondents that Latin has now ceased to be employed as the international language of science, although for more than a thousand years after it had ceased to be a vernacular it had, among men of education, maintained its position as a living language, adapting itself to the varying needs of the times. I have devoted some attention to the development during the Middle Ages and succeeding centuries of the branches of science in which I am more especially interested, and have been struck by the clear, fluent Latin in which the majority of the scientific treatises were written. That of Agricola, Encelius (Entzelt), Gesner, Camden, and Cæsalpinus in the sixteenth century; Francisco Imperato and Aldrovandi in the seventeenth; and Isaac Lawson, Cramer, and Linnæus in the eighteenth, and most of their fellow-workers is, as a rule, as easy to follow as French, in spite of the handicap of the want of articles, the most serious defect of Latin.

It was the Latinists themselves who were primarily responsible for the modern disuse of the language. They insisted that the diction of Cicero, rather than that of Pliny, should be followed, and as they spoke with authority, there was no one hardy enough to contradict them, so that the unfortunate man of science had to face a hail of ridicule if he failed to reproduce the mannerisms which were held up for his imitation, while if he succeeded his pages were almost unreadable for most of those who would have been interested in their contents.

If Latin were ever again to come into use for scientific purposes, it would only be by assimilating its style and idioms to those of its daughter languages at the present time, by accommodating itself to the changes of meaning which have overtaken so many of its words, and by borrowing freely from their vocabulary, especially in the case of terms which are practically international. At the same time the inflexions and syntax of classical Latin would be generally, but not slavishly, followed.

I am afraid, however, that it is too late to undo the work of those who have slain the object of their affections by strenuous efforts to renew the golden age of its early youth when by far the more important portion of its long career of usefulness still lay before it; and now that it is, as it would seem, really dead, had we not better regretfully but resolutely bury it out of sight and turn our thoughts to the flexible idiom handed down to us by our forefathers, which is already understood throughout the whole civilised world? John W. Evans.

Imperial College of Science and Technology, South Kensington, March 28.

Osmotic Pressure or Osmotic Suction—Which?

The interesting controversy between Profs. van Laar and Ehrenfest, referred to in Nature of March 16, again raises the question of the cause for the approximate equality between osmotic pressure and gas pressure. In this connection the following simple proof, based on the kinetic theory, of van't Hoff's well-known relationship, may be of interest.

The tendency of a liquid to diffuse is measured by its diffusion pressure, which may be defined as the bombardment pressure exerted by the liquid molecules on either side of a plane of unit area placed anywhere within the liquid. If we regard a perfect liquid as formed by the compression of a perfect gas until the molecules almost touch one another, it will be seen that the diffusion pressure is proportional to the number of molecules in unit volume, or the absolute concentration, and also to the absolute temperature. The diffusion pressure for ordinary liquids has a very large value. For instance, if water were a perfect liquid, its diffusion pressure would be about 1200 atmospheres.

Since the absolute concentration of a solvent is reduced by the introduction of a solute, it is evident that diffusion pressure is reduced in the same way; so that the diffusion pressure of the solvent in a solution is always less than that in the pure solvent itself. Hence solvent travels across a membrane from the pure solvent side to the solution side, unless a hydrostatic pressure equal to the difference between the two diffusion pressures is placed on the solution. The osmotic pressure, which is defined as the aforesaid hydrostatic pressure, is therefore proportional to the difference between the absolute concentrations of the *solvent* on the two sides of the membrane. Further, it is also approximately proportional to the concentration of the solute because the latter is itself approximately equal to the difference in solvent concentration on the two sides, since the process of solution consists essentially in the spatial replacement of part of the solvent molecules by a more or less equal number of solute molecules.

Next as regards the gas relationship. Consider the case of a pure solvent separated from its solution by means of a semipermeable membrane (diagram I.). Remove from the solution side *all* the solvent molecules; and also an equal number from the pure solvent side. The system then assumes the appearance shown in diagram II. Now this process merely reduces the absolute concentrations and diffusion pressures on the two sides of the membrane to an equal extent; but leaves unaltered the *differences*. The residue of solvent molecules [⊙] will diffuse across the membrane just as before; whilst the solute molecules will bombard the membrane. Moreover, the pressure of the solvent residue on the one side will be equal to the pressure of the solute on the other; and both will be equal to the corresponding gas pressure, since the molecules are at distances from one another comparable to gas distances. Hence to prevent the residue of solvent from flowing across the membrane, a hydrostatic pressure equal to the gas pressure will have to be applied. The usual way of doing this is to make the solution into a kind of piston.

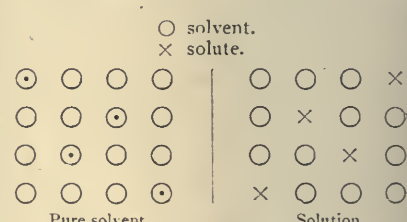


Diagram I.

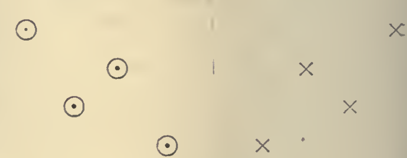


Diagram II.

On the other hand, the solute bombards the membrane with a pressure equal to the corresponding gas pressure, whether a hydrostatic pressure is placed on the solution or not. The solvent itself can exert no pressure on the membrane, since it is supposed to be able to travel across the membrane just as if the latter were non-existent.

The phenomenon of osmotic flow is therefore due to the residue or excess of *solvent* molecules on the pure solvent side; the solute molecules play an indirect part only. But the solute molecules do cause a strain to be placed on the membrane, which tends to rupture the latter.

The fundamental difference between osmotic phenomena in the gaseous and solution states is that whereas the active molecules (see diagram II.) have a vacuum for a medium in the gaseous case, they have a liquid solvent for a medium in the solution case. The other differences between compressed gases and concentrated solutions nearly all proceed from this fundamental one.

FRANK TINKER.

University of Birmingham, March 21.

The Expansion of a Homogeneous Function in Spherical Harmonics.

IN a recent paper, entitled "Notes on Spherical Harmonics" (Proceedings of the Edinburgh Mathematical Society, vol. xxxii., 1914), Dr. John Dougall wrongly claims as new the expansion which he has given there for a homogeneous function of the coordinates of a point on a sphere. This expansion was first given in 1900 by Dr. G. Prasad, in the *Messenger of Mathematics,* vol. xxx., p. 13, and again, by a different method, in 1912 in the *Mathematische Annalen,* vol. lxxii., p. 436. The method of Dr. Prasad in the second paper is the same as that of Dr. Dougall.

S. K. BANERJI.

Calcutta Mathematical Society,
University College of Science, Calcutta, March 8.

PREVENTIVE EUGENICS.[1]

LORD SYDENHAM and his colleagues deserve the thanks of the nation for their prompt and faithful discharge of the difficult task allotted to them, in November, 1913, of inquiring into the prevalence of venereal diseases in the United Kingdom, their effects upon the health of the community, and the means by which those effects can be alleviated or prevented. No one can read the commissioners' report without an increased conviction of the seriousness of the evil that is dealt with, of its grave and far-reaching effects (even on the biological plane alone) upon the individual and the race. In careful terms and with scientific precision the commissioners give the evidence for the statement that the effects of the diseases in question "cannot be too seriously regarded," for "they result in a heavy loss, not only of actual, but of potential population, of productive power and of expenditure actually entailed." The misery account cannot be estimated.

Except in the case of the Navy and Army, there are at present no means of arriving at an accurate estimate of the prevalence of venereal diseases in Britain, and many deaths due to them appear to escape official recognition. Sir William Osler considers that, "of the killing diseases, syphilis comes third or fourth," and the commissioners, while rightly cautious, conclude that the number of persons who have been infected with this disease, acquired or congenital, cannot fall below 10 per cent. of the whole population in the large cities, and that the percentage affected with gonorrhœa must be much larger. As regards geographical distribution, syphilis is shown to be essentially a town disease. As regards the social distribution of venereal diseases as a whole, there is high incidence (in descending order) among unskilled labourers, in those intermediate between them and skilled labourers, and in the upper and middle classes. There is relatively low incidence among (in descending order) textile workers, miners, and agricultural labourers. It is regrettable that the statistics, both of total prevalence and of distribution, remain somewhat uncertain. It is also to be regretted that the commissioners have allowed themselves to speak repeatedly of "hereditary syphilis"—a quite inaccurate phrase.

One of the most tragic aspects of this widespread human scourge is the suffering inflicted on the innocent. Children infected before birth may be blinded or deafened, or terribly diseased in skin and bone, in body and mind. More than half of all cases of blindness among children are the result of venereal diseases in their parents. Of registered still-births, probably at least half are due to syphilis, and it is estimated that from 30 to 50 per cent. of sterility among women is due to gonorrhœa. The "suffering incalculable" that may be inflicted on an innocent mother, taken along with wrong done to the offspring and other possible consequences, have led the commissioners to the recommendation that the presence of communicable venereal disease should be regarded as a disqualification for marriage and as a ground for a declaration of nullity—without, of course, affecting the legitimacy of the children. Those who still think that nothing should be done to make the cure of the diseases easier, because this lessens the punishment of the guilty and makes indulgence safer, should consider carefully the section of the report which deals with the consequences to mothers and children. We confess that it overwhelms us in its awfulness. There is also to be borne in mind the terribleness of the nemesis involved in the occurrence in the offender himself of general paralysis or locomotor ataxy, it may be ten or fifteen years after the infection. An even wider consideration, especially in these days of wastage, is the "enormous" economic loss traceable to reduced working capacity, and the heavy public cost of maintaining the various kinds of patients. The commissioners are convinced that the cost of curative and preventive measures would soon be counterbalanced by what would be saved.

We are not here concerned with the medical measures by which, according to the commissioners, the diseases can be controlled and reduced within narrow limits, but we wish to direct attention to two accessory points:—(1) There is a wholesome eugenic breeze in the suggestion that a warning given by a physician in regard to the undesirability of a marriage shall be regarded as

[1] Royal Commission on Venereal Diseases. Final Report of the Commissioners. Presented to both Houses of Parliament by Command of His Majesty. Pp. 191. (London: Wyman and Sons, Ltd., 1916.) Price 1s. 11d.

a privileged communication. We do not sympathise with those who regard it as an infringement of liberty to require, as a matter of course, a medical certificate on both sides before marriage, for this is surely a social as well as a personal matter, and we have a well-grounded confidence in the general wisdom of the medical profession—a wisdom which would be more generously displayed if it were more frankly and courteously appealed to. (2) The commissioners are strongly convinced that it is time to let in more daylight. Medical students should have more adequate instruction in regard to these scourges of the race; the public should be authoritatively informed (*e.g.*, by literature which has received the imprimatur of the National Council for Combating Venereal Diseases) as to the biological gist of the matter (of which most know nothing), and as to parasitological commonplaces, *e.g.* regarding exchange of pipes or tooth-brushes; students in training colleges should be carefully prepared so that they may be able to guide and advise senior pupils; the practice, followed by some head-teachers, of warning and encouraging pupils before they leave school should be general; instruction should also be given in evening continuation schools (we doubt the wisdom of including factories and workshops); use should be made of those voluntary associations that show a sufficiently high standard of efficiency and tact; and, last but not least, "the guidance of medical practitioners should be secured."

All this is, in its general trend at least, wise counsel, which should be made the basis of earnest experiment towards lessening one of the disgraces of our civilisation. We would add, however, a plea that the instruction, for lack of which many perish miserably, should not be restricted to the pathological and prudential aspects, but should be broadened out into positive eugenic education, with a frank recognition, for instance, that wholesome, full-blooded, high-minded love, in spite of the awfulness of its *corruptio optimi pessima*, is the finest thing in human life.

In connection with this terrible subject there is a brilliant record of scientific achievement. Thus we may remember Neisser's discovery of the micro-organism (*Gonococcus*) that causes gonorrhœa; the pioneer experiments of Metchnikoff and Roux; Schaudinn's discovery of the micro-organism (*Spirochaeta pallida*) that causes syphilis; Noguchi's observation of the occurrence of the spirochæte in the brains of persons dying of general paralysis and locomotor ataxy; Wassermann's suggestion of a valuable diagnostic bio-chemical test; Ehrlich's working out of the salvarsan cure, for which there are now various substitutes available. Such records make us proud of mankind, but the reason for it all fills us with shame. The commissioners are wise enough to discern that men become victims of vicious circles. Overcrowded and insanitary dwellings indirectly contribute to the spread of the diseases in question; occupational depression leads to alcoholism, and the "communication of disease is frequently due to indulgence in intoxicants"; and so the dismal circles run.

Biologically regarded, the measures proposed by the commissioners must be approved of without hesitation. Two invisible parasites cause widespread human misery; science has mastered these parasites; and, if men will, the misery may in greater part, or altogether, cease. But to consider man from the biological point of view alone is a fallacious and, indeed, impossible abstraction. For he is a rational, social person, a member of a realm of ends as well as of the class of mammals. Thus the question arises—and who is wise enough to answer it?—whether our scientific saving of the sinner from the punishment of his sins—always a dangerous thing to do—will be justified in the long run by a finer race. In actual fact, however, there is no alternative, for social instinct, with the obsolescence of patriarchal ways of looking at things, is now strong enough to secure that women and children be shielded, so far as available science makes it possible, from the effects of masculine selfishness.

The terms of the commissioners' reference precluded consideration of the moral aspects of the questions with which they had to deal, but there is no dubiety as to the firm ethical undertone of the report. "We are deeply sensible of the need and importance of the appeals to conscience and honour which are made by the religious bodies and by associations formed for this purpose. We believe that these appeals will gain force if the terrible effects of venereal disease upon innocent children and other persons who have no vicious tendencies are more fully realised."

We have exceeded the space editorially allotted to us, but we plead that this is one of the most important bio-sociological documents of recent years, and we wish to quote its well-considered final appeal:—

> The diminution of the best manhood of the nation, due to the losses of the war, must tell heavily upon the birth-rate—already declining—and upon the numbers of efficient workers. The reasons for combating, by every possible means, diseases which in normal times operate with disastrous effects alike upon the birth-rate and upon working efficiency are, therefore, far more urgent than ever before. Now and in years to come the question of public health must be a matter of paramount national importance, and no short-sighted parsimony should be permitted to stand in the way of all means that science can suggest and organisation can supply for guarding the present and future generations upon which the restoration of national prosperity must depend.

THE MANUFACTURE OF PORCELAIN.

In early days almost nothing was accurately known of the manufacture of porcelain. European potters had never made ware with such admirable qualities as that which was brought by the traders from China, and their attempts to imitate Chinese porcelain were not very successful. The first synthetical experiments were based on the hypothesis that Chinese porcelain was a

levitrified glass, or a glass opacified by the addition of clay; afterwards Böttger, a pupil of Walther von Tschirnhaus, who had had a great deal of experience in the manufacture of crucibles for his alchemical work, made a vitreous body which had some of the qualities of porcelain, but an objectionable colour. The ware was very vitreous and no glaze was used; Böttger seems to have tried to get the bright glossy surface by polishing the body. Böttger then found a deposit of white clay at Aue, near Schneeburg, and, by using that in place of the crucible clay, he was able to produce fair imitations of the body of Chinese porcelain, and a works was started near Meissen in which extreme precautions were taken to preserve the secret. This porcelain was the type now known as hard or felspathic porcelain. A generalised hard porcelain body has the composition :—

Clay	50
Felspar	25
Quartz	25

The discovery of china clay at St. Yrieix, in France, enabled the French potters to take up the manufacture of this same type of porcelain, but in France a totally different type of porcelain was in use. It was called soft porcelain. The composition of soft porcelain can be generalised into the recipe :—

Calcareous clay	30
Glassy frit	30
Quartz	40

Soft porcelain lent itself peculiarly well to the production of beautiful pottery, but the cost of manufacture was too great to enable it to compete successfully with the bone china and hard porcelain; as a result, the soft porcelain industry is virtually dead. Artificial teeth, however, are made from a variety of soft porcelain.

Cookworthy, of Plymouth, discovered that the Cornish stone and china clay of Cornwall could be employed for making a porcelain body, and works were started at Plymouth. The English hard porcelain, while preserving a special character of its own, belonged to the same general type as the German and Chinese. The manufacture of this hard porcelain in England does not appear to have been very successful, and was soon abandoned. A third type of porcelain developed in England, the English porcelain, or bone china. The body of this can be generalised in the recipe :—

Bone ash	50
Clay	25
Cornish stone	25

We have considered only the body of the various porcelains. The composition and character of the various glazes are of equal importance. Shortly, hard porcelain, which matures at the glaze temperature—which is very high—has a hard glaze of the nature of felspar; soft porcelain had a lead glaze which matured at a comparatively low temperature.

The manufacture of pottery is very largely dependent upon a multitude of conditions, each one of which might appear to be of little intrinsic importance. Successful potting involves close attention to detail, and this probably more than in any other industry.

There is a marked difference in the behaviour of these three types of ware in the firing. In all types of pottery there is a range of temperature or margin of safety outside which the fireman must not go. If the temperature be *above* these limits the ware is liable to be spoiled; and if *below*, the ware is insufficiently fired. With hard porcelain there is a particularly wide margin of safety; with soft porcelain the margin of safety is so narrow and the resulting losses so great that the manufacture had to be abandoned as commercially impracticable. With English bone china, too, there is a comparatively narrow margin of safety, which is necessarily attended by proportionate difficulties.

Hard porcelain, unlike soft porcelain and bone china, is first baked at a comparatively low temperature, and the glaze and body are subsequently fired together at the higher temperature. The preliminary baking is not a critical operation, and it can virtually be done by the waste heat of ovens firing at the higher temperature. With soft porcelain and bone china two critical firings are needed; with hard porcelain there is one. The first or biscuit fire with soft porcelain and bone china is much the hotter; the second or glost fire is not so hot.

Hard or felspathic porcelain and bone china virtually command the world's porcelain market. Both forms are *porcelain*, and both are colloquially called *china*, although the latter term is more commonly applied to the English porcelain as distinct from the Continental. It appears that in quality—presumably æsthetic—British porcelain reigns supreme; but in certain special lines—chemical, electrical, and possibly hotel ware—the Continental porcelain has important advantages which render it advisable to start seriously making it in England. Just as the manufacture of the British type of porcelain has not been particularly successful outside this country, so the manufacture of Continental porcelain has not been successful here. The two types have developed on different lines, and certain radical differences obtain, so that certain conditions necessary for success in the one lead to failure in the other. The cessation of German supplies of chemical ware has led manufacturers to make fairly good imitations of hard porcelain by modifying parian, insulator, and mortar bodies, but these temporary imitations are not so satisfactory as the true hard porcelain. The problem must be solved by our taking up the manufacture of true hard porcelain, and not frittering away valuable time on imitations which past experience has proved to be less suitable for the work. The manufacture should offer no insuperable difficulties to our men once their skill is deflected and adapted to suit the special conditions required for the new type of ware. The subject wants tackling boldly and confidently on a large scale with British raw materials. If much raw

material has to be purchased abroad the cost of production will rise accordingly.

This seems a very good opportunity for State assistance, since at present it is to the interest of no individual manufacturer to assist in the development of the new type of ware. It is therefore pleasing to learn that the Committee of the Privy Council for Scientific and Industrial Research has made a substantial grant towards the capital outlay for an experimental factory where the conditions necessary for the successful manufacture of hard porcelain can be studied on a large enough scale to reproduce manufacturing conditions. Once the necessary conditions have been established, the manufacture of hard porcelain will probably interest a great many potters, and this idea has probably led the Pottery Manufacturers' Association to bear a proportionate part of the estimated cost of maintenance. Instead of working slavishly on Continental lines it will probably be far more rational to introduce as few radical changes as possible, so that the supreme skill and traditional experience of our craftsmen may be utilised to its maximum. In this way it is quite likely that a new kind of hard porcelain will be evolved, which will unite the good qualities of the Continental with those of the British porcelain.

B. M.
J. W. M.

THE COMMONWEALTH INSTITUTE OF SCIENCE AND INDUSTRY.

The scheme for the establishment of a Commonwealth Institute of Science and Industry, of which we gave an account in our issue of March 9, is described by Prof. Orme Masson in an interesting article in the Melbourne *Argus* of January 22. Prof. Masson points out that, just as Lord Roberts pleaded in vain the military necessities of the nation, so the warnings of men like Sir Henry Roscoe, Sir William Ramsay, and Sir Norman Lockyer, as to the consequences of the neglect of science, were disregarded before the war. After the scheme for the development of scientific and industrial research, under a committee of the Privy Council, had been put forward about a year ago, Mr. Hughes, the Prime Minister of Australia, determined to do as much—and more—for the Commonwealth, with the view of making the country independent of German trade and manufacture when the war is over. Following the example of the British Science Guild ten years ago, he appointed a committee representing State scientific departments, universities, and industrial interests to prepare a scheme; and within a few days the committee had produced the draft already published in our columns.

The proposed Institute is to be governed by three directors, one of whom will be selected for proved ability in business, finance, and organisation; while the two others will be scientific men of similar high standing and reputation. This combination, devoted wholly to the work, should be able efficiently to conduct affairs and operations having for their object the union of science with industry. The directors are to be assisted by an advisory council composed of nine representatives of primary and secondary industries and of science; and these representatives are to seek information, advice, and assistance from specialists throughout Australia.

The first function of the Institute will be to ascertain what industrial problems are most pressing and most likely to yield to scientific experimental investigation; to seek out the most competent men to whom each such research may be entrusted; and to arrange for their having all necessary appliances and assistance. The Institute is also to build up a bureau of industrial scientific information, which shall be at the service of all concerned in the industries and manufactures of the Commonwealth. Its third main function will be to erect, staff, and control special research laboratories, the first of which will probably be a physical laboratory somewhat on the lines of our National Physical Laboratory.

The scheme cannot be brought into operation until it receives the sanction of the Commonwealth Parliament, after the return of Mr. Hughes from his visit to England. In the meantime, the Federal Government has appointed a temporary advisory council and provided the money necessary to enable it to make a beginning with the organisation of industrial scientific research and the collection and dissemination of scientific information bearing on Australian industries. According to Press reports, Mr. Hughes said, before leaving Australia, that the Government is prepared to spend up to 500,000*l.* upon the establishment of the scheme; and if the matter is taken up in this large-minded spirit the Commonwealth will have made the best possible provision for the industrial and commercial struggle which must come after the declaration of peace.

NOTES.

Promoters of the proposal to put the hands of timepieces forward by an hour during certain months of the year are now advocating the adoption of this principle of "Daylight Saving" by deception on the grounds of national economy in fuel and light. The scheme has been before the public for many years and has been rejected by Parliament on more than one occasion. It has not received the approval of a single scientific society of any importance, and only one or two scientific men have given it any support. Yet Lord Salvesen made the astounding assertion in the *Times* of March 31, that the Daylight Saving Bill "is supported by substantially the whole intelligent opinion of the country." He evidently believes that "intelligent opinion" upon time-standards is not to be found in the views of experts, but in the resolutions of town councils, district councils, chambers of commerce, and like bodies, who want to pretend that during a prescribed period every year the hour of seven o'clock is really eight, and so for other hours. It is usually understood that people cannot be made sober by Act of Parliament, yet it is seriously suggested that they should be made to rise earlier by a legalised plan of national deception. We have condemned this ridiculous measure whenever it has been

brought forward, and dealt with it in detail in an article in NATURE of May 11, 1911 (vol. lxxxvi., p. 349). A correspondent suggests that we should reprint this article, but we doubt whether the corporations who want Parliament to do for them what they could do for themselves by changing their habits would be convinced by any appeal to authoritative opinion. They might not be in favour of altering temperature standards during certain months of the year, so that in the summer 80° shall be called 70° by Act of Parliament, in order to pretend that the weather is not really so hot as the thermometer indicates, yet the principle which they adopt so cheerfully is precisely the same. If they understood the meaning of time-standards so well as they know those of length, weight, and temperature, the "Daylight Saving" scheme would long since have passed into the limbo of forgotten things.

THE enterprise of the *Times* in the issuing of an "Imperial and Foreign Trade Supplement," to be continued monthly, is both commendable and timely. The purpose is to bring enlightenment to the British producer and merchant, and to induce them to support measures sound in policy and method with a view to enable them to compete on advantageous terms, both at home and abroad, with their foreign rivals, especially those of Germany. A frank, well-informed, and unprejudiced discussion of the intricate problems involved, having always the welfare of the home consumer in mind, can result in nothing but good. An instructive article is contributed by Sir Philip Magnus on the value of science in its application to commerce and industry, in which the economic success of Germany and the results of her peaceful, penetrating efforts throughout several decades are ascribed to the effective school training, which has not only enabled the citizens to develop in their own country new and profitable industrial undertakings, but also to establish themselves in a dominating commercial position in other countries. Drastic changes are urged in respect of the organisation of our education, not necessarily on German lines, throughout all its grades, but especially in the training given in our universities and technological schools, which is compared very unfavourably with that available in similar German institutions, and with the number of students engaged therein in operations involving specialised scientific research. There is also an important article by Sir Algernon Firth on British trade policy, in which reference is made to the recent great commercial conference held in the Guildhall, and to the approval given to the demand that the Empire should produce within its own borders all that it requires from its own soil and factories, and that the Government should be urged to provide larger funds for the promotion of scientific research and training. Only the barest allusion is made, however, to this necessity in communications received from numerous correspondents throughout the country, the chief stress being laid upon fiscal restrictions.

THERE is still no news of Sir Ernest Shackleton's ship *Endurance*, but that need not increase the anxiety as to her safety, as, owing to the unfavourable ice season, her return may be delayed until the middle of April. The *Aurora* was towed into Port Chalmers, New Zealand, on Monday, April 3. It appears that on May 6, 1915, a violent gale tore the vessel from her moorings, and that she was then carried with the ice to the north. The rudder was crushed on July 21, and the vessel was not able to emerge from the ice until March 1 4last last, when it was in a badly damaged condition. Whether the *Aurora* will be fit to return to the Ross Sea in the next Antarctic summer appears doubtful. The fact that she had to be towed during the last part of her voyage to New Zealand was due to the loss of her rudder, though a jury rudder was rigged up. The cautious remarks attributed by the cable to Mr. Stenhouse, the chief officer of the *Aurora*, suggest, however, doubt as to whether, in his opinion, the *Aurora* will be available. He is reported to have expressed the hope that the staff of the *Aurora* will return as a relief party, but he says nothing as to the return of the ship herself. We must hope, however, by next week to have news of the *Endurance*, and of the seaworthiness of the *Aurora*.

DR. M. O. FORSTER, F.R.S., the chairman of the Technical Committee of British Dyes, Ltd., and Mr. J. Turner, the manager of the works, have been offered, and have accepted, seats on the board of the company, and Dr. J. C. Cain has been appointed chief chemist of the new works at present under construction at Dalton, Huddersfield.

WE regret to announce the death, on April 4, in his eighty-first year, of Sir John Gorst, F.R.S., vice-president of the Committee of Council on Education from 1895 to 1902, and the first president of the Educational Science Section of the British Association.

MR. W. B. HARDY, Sec.R.S., Admiral Sir H. B. Jackson, K.C.B., F.R.S., and Sir G. A. Smith, Principal and Vice-Chancellor of Aberdeen University, have been elected members of the Athenæum Club under the rule which empowers the annual election of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

THE day lectures at the Royal Institution after Easter include:—Prof. C. S. Sherrington, Harvey and Pavloff; Dr. T. M. Lowry, optical research and chemical progress; Sir Ray Lankester, flints and flint implements; Prof. W. H. Bragg, X-rays and crystals (the Tyndall lectures); Prof. H. S. Foxwell, the finance of the great war; Sir James G. Frazer, folk-lore in the Old Testament. The Friday evening discourses include:—Sir J. M. Davidson, electrical methods in surgical advance; Colonel E. H. Hills, the movements of the earth's pole; Prof. C. G. Barkla, X-rays; Mr. E. Clarke, eyesight and the war.

DR. H. R. MILL reports in the *Times* of April 3 that while the average rainfall for March at Camden Square for fifty years is 1·75 in., this year the total rainfall, including melted snow, up to a few hours before the end of the month, was 4·67 in. The record of rainfall at Greenwich Observatory for the past 100 years includes only one instance of a 4-in. fall in March, 4·05 in. having been measured in 1851. A search through the numerous rainfall records kept in and near London back to the beginning of the eighteenth century has failed to show any March with as much as 4 in. of rain.

THE annual general meeting of the Ray Society was held on March 23, Prof. W. C. McIntosh, president, in the chair. The report of the council showed a considerable loss of membership owing to the war, and stated that two volumes for 1915, the "Principles of Plant-Teratology," vol. i., by Mr. W. C. Worsdell, and the "British Fresh-water Rhizopoda and Heliozoa," vol. iii., by Mr. G. H. Wailes, had been issued to the members, and also the "British Marine Annelids," vol. iii., part 2, by the president, being one of the issues for the present year, for which the second and concluding volume of "Plant-Teratology" is also in preparation. A work on the "Trematode Parasites of British Marine Fishes," by Dr. William Nicoll, and one on the "British Diatomaceæ," by Mr. George

West, had been accepted for publication. Prof. McIntosh was re-elected president, Dr. F. DuCane Godman treasurer, and Mr. John Hopkinson secretary.

THE annual general meeting of the Chemical Society was held at Burlington House on March 30, Dr. Alexander Scott, president, in the chair. A discussion took place with regard to the removal from the list of those honorary and foreign members who are alien enemies, and it was decided to refer the matter to the council for further consideration. It was with great pleasure the president announced that the following donations had been made to the research fund:—(*a*) 1000*l*. from Dr. G. B. Longstaff, whose father, by his gift of a similar amount, was largely instrumental in founding the research fund forty years ago; (*b*) 1000*l*. from Mrs. and Miss Müller, in commemoration of the late Dr. Hugo Müller's long connection with the society; (*c*) 500*l*. from Dr. Alexander Scott, to mark his appreciation of the valuable work done by the research fund, and in commemoration of the seventy-fifth anniversary of the society. Prof. G. G. Henderson and Prof. A. Lapworth were elected new vice-presidents, and Mr. A. Chaston Chapman, Mr. C. A. Hill, Dr. R. H. Pickard, and Dr. F. L. Pyman were elected as new ordinary members of council. The delivery of the president's address, entitled "Our Seventy-fifth Anniversary," was postponed until to-day, April 6, at 8 p.m.

SIR RICHARD REDMAYNE, in his presidential address delivered recently before the institution of Mining and Metallury, took as his main theme a consideration of the mineral resources of the United Kingdom. Coal, as the most important mineral asset, came in for the principal treatment, which consisted in a survey of possible extensions of coal-fields and the prevention of waste in the acquisition and utilisation of coal. Iron ore and limestone were next reviewed, and, finally, the resources of non-ferrous metals, with the last of which the institution is by its constitution principally concerned. This gave the president the opportunity of explaining to members in some detail the scheme of research which is about to be undertaken by the institution in co-operation with the Royal Cornwall Polytechnic Society, and with the aid of a financial grant from the Advisory Council to the Committee of Scientific and Industrial Research of the Privy Council. The research will deal with the economic extraction of tin and tungsten from Cornish ores, and its objects are:—(*a*) To review the evidence upon which estimates of the total contents and recovery of tin and tungsten are based; (*b*) to co-ordinate and complete the researches already begun, and if necessary to institute other researches on new lines; and (*c*) to suggest new or improved methods of treatment indicated by the results of the researches. It is remarkable that in spite of the antiquity of this industry the precise percentage of recovery now being obtained of cassiterite from the tinstone is not known, though there is a consensus of opinion that it certainly does not exceed 75 per cent.

THE name of Auguste Rosenstiehl, whose death is announced, is indissolubly linked to that period of chemistry which inaugurated the great colour industry. Born at Strasburg in 1839, he completed his studies in the university of his native town, where he remained as lecture assistant from 1857 to 1865. Having chosen the study of tinctorial chemistry as a career, he was appointed to the chair of chemistry at the technical school at Mulhouse, of which he was afterwards director. Subsequently he acted as colour chemist to a firm of dyers. In 1877 he accepted a post in the celebrated colour works of Poirrier and Dalsace, of Saint Denis, with which the names of Lauth, Gerard, Roussin, Bardy, and many other distinguished chemists are connected. It is to Rosenstiehl that the elucidation of the formation of fuchsine, discovered by Verguin, is due. He also studied the chemistry of alizarine and the other colouring principles associated with the madder root, among the derivatives of which nitroalizarin soon received practical application in the dyeing industry. In collaboration with Noelting, director of the School of Chemistry of Mulhouse, Rosenstiehl prepared Saint Denis red, an azo-colour which led the way to the manufacture of numerous derivatives of the same group. The chemistry of dyestuffs and dyeing were not the only subjects which absorbed Rosenstiehl's attention, for he was also interested in the study of physics and the physiology of colour. Later, Rosenstiehl was appointed to the chair of colour chemistry at the Conservatoire des Arts et Métiers. His views on osmosis, which he attributed to osmotic pressure, were confirmed some years later by Van't Hoff, who pointed out the analogy with gas pressure. Among the honours conferred upon him, the Academy of Sciences awarded him a few years ago the Jecker prize for his services to colour chemistry.

THE prevalent belief that immature veal is far less nutritious food than beef is examined by W. N. Berg in a recent paper in the Washington Journal of Agricultural Research (vol. v., No. 15). He finds that no chemical difference of physiological importance can be detected between the two kinds of meat, nor does artificial digestion work more rapidly on beef than on veal, while kittens in the diet of which immature veal was the only source of nitrogen grew normally into healthy cats, the offspring of which, in their turn, throve also on the same food.

IN a recent issue (February 3, p. 630) we alluded to the important part played by the Benedict calorimeter in the investigation of metabolism. A striking illustration of this is afforded in a recent publication by Prof. Benedict ("The Physiology of the New-born Infant," by F. G. Benedict and F. B. Talbot; Carnegie Institution of Washington, No. 233, 1915). Normal infants only have been studied so far as a preliminary to a more extended pathological investigation; the Boston Lying-in Hospital provided the material (100 babies), and a constant routine was adhered to in all cases. The data obtained show that on the first day of life there are important disturbances of the regulation of temperature which result either in a decreased metabolism, or, when the infant makes efforts to compensate for the loss of heat, there is increase in the metabolism. After the second day there is a fair uniformity in the heat production per square metre of body surface, and a remarkable uniformity per square metre of body surface per unit of length. This constancy is such as to permit the establishment of a factor which indicates that when the square metre as computed from the body weight is divided by the length, the metabolism per unit is 12·65 calories. The practical outcome of this is the following:—From a study of the effect of temperature changes on the basal metabolism and the amount of available breast secretion in the first week of life, it is possible to indicate what procedure should be adopted for the conservation of energy and supplemental feeding.

In the March number of the *Zoologist* Miss Frances Pitt discusses the habits of the yellow-necked mouse, both in a wild state and in captivity. One of its most striking characteristics seems to be its pugnacity. As she remarks, we have yet much to learn in regard to the range of this handsome mouse in England, but it occurs so far north as Northumber-

land, and is met with also in the Midlands. Miss Pitt seems to be under the impression that it is found only in the south and west of England.

In an account of his observations on the feeding habits of the purple-tipped sea-urchin (*Echinus miliaris*), which he contributes to the *Zoologist* for March, Mr. H. N. Milligan adds a number of new facts which are well worth recording. The diet of these animals ranges from bits of chalk to living fish and mollusca; nothing seems to come amiss to them. The cast shells of crustacea are eaten with the same avidity as the dead animal. When legs of crustacea are placed near them they are partly eaten, and the remaining portions are carried up by the tube feet and placed upon the back, to serve apparently as a disguise. How they discover and locate the position of edible morsels is yet unknown, but Mr. Milligan, by means of an ingenious experiment, has shown that they soon detect the introduction of food into the tank in which they are confined, and, furthermore, make strenuous efforts to seize it when it is placed out of reach.

A REPORT on the chlorosis of the tobacco plant, generally known as "calico," is published by Mr. G. P. Clinton in the Connecticut Experimental Station Report for 1914. "Calico" is an infectious and, to a certain extent, a contagious disease which can be communicated by mere contact of calicoed plants or their juice with healthy plants. Infected plants in the seed-bed are probably primarily responsible for most of the calico in the fields. The disease is remarkable in appearing to be due, not to bacterial or fungoid agencies, but to an enzymic "virus." The virus can be filtered through a Berkefeld filter, and can be extracted from calicoed leaves by antiseptic solvents such as ether, chloroform, and alcohol, and the infected juice has its activity preserved by adding toluene. A number of precautionary measures are given for dealing with the disease and a useful bibliography of the subject.

AMONG the foreign guests of the British Association in Australia in 1914 was Dr. C. H. Ostenfeld, of Copenhagen, who has now published his observations on the vegetation of Western Australia (*Geografisk Tidskrift*, xxiii., 1915, pp. 35–46 and 132–48). He divides Western Australia into three climatic regions, each with a characteristic vegetation, tropical, central and north-west and south-west. The last region has the greatest rainfall, and is most important. It falls into three belts, depending on rainfall, which are named respectively the cattle, wheat, and timber belts, but since one or other species of eucalyptus characterises each belt of increasing rainfall from the interior to the sea, Dr. Ostenfeld proposes another and stricter classification into five belts. The Wandoo belt (*E. redunca*), with 450 to 700 mm. annual rainfall; the Jarrah belt (*E. marginata*), 700–1000 mm.; the Tuart belt (*E. gomphocephala*), about 900 mm.; the Karri belt (*E. diversicolor*), 1000–1200 mm.; and the coast scrub, with *Agonis flexuosa* and Acacia, on the sea cliffs. The Jarrah belt is the most important, not merely on account of its timber, but also for its cattle-farming and fruit-growing. The paper is well illustrated.

In the *Journal of the Royal Society of Arts* for January 28, a review of the work of the British Cotton-growing Association since its formation in 1902 is given by Mr. J. A. Hutton, chairman of the council of the association. To the activities of the association the successful cultivation of cotton in many parts of the Empire is due, and in particular Uganda, Egypt, and the West Indies may be cited. In Uganda the first export of cotton took place in 1904, when 54 bales were shipped, and in 1914 the shipment had risen to 40,000 bales. The transport facilities afforded by the Uganda Railway have made possible this successful cultivation, and in Nyasaland the extension of the Shire railway to Chindio, an enterprise largely helped by the association, will no doubt bring beneficial results to the cotton industry in the Protectorate. The association has made experiments in British colonies, both suitable and unsuitable, and has many failures to record, particularly in West Africa, where either conditions of climate were unsuitable or other crops were preferred by the native growers. In many colonies the association has been instrumental in hastening the formation of agricultural departments, with which it is now working in close harmony. Owing to the existence of the efficient Imperial Department of Agriculture in the West Indies, the Cotton-growing Association has been able to render very great help to the West Indian islands, and the cotton from that region is highly appreciated by the spinners in Liverpool.

A BLIZZARD of unusual severity swept over the British Isles on March 27 and 28, causing a large amount of damage, both on land and sea, with some loss of life. In London the weather changes indicated the passage of a double-centred disturbance, or a parent storm and its subsidiary. The first disturbance reached its maximum force late on Monday evening, March 27, when the barometer in London fell below 29 in. The gale was from the south-west and was accompanied by heavy rain and snow. The wind had abated on Tuesday morning, but the barometer remained low. In the afternoon the mercury rose briskly and the wind shifted to the northward, blowing a severe gale in the early evening of March 28, with heavy, driving snow. On the morning of March 29 the barometer had risen an inch in the twenty-four hours. The velocity of the wind is given as 70 to 80 miles an hour in parts of England, and in London early on the evening of March 28 the rate was about 60 miles an hour.

Symons's Meteorological Magazine for March gives a rainfall table for February, 1916, which shows that the month was wet over nearly the whole of the British Isles, Aberdeen being the only station among those chosen for the tentative results with a deficiency of rain. The total rainfall during the month is said to have been most excessive in the south-east of England generally, the fall being more than double the average to the south of a line drawn from Hull to Cardiff. The greatest excess of rain at the given stations occurred in Derbyshire, the measurement at Mickleover being 289 per cent. of the average. At Bury St. Edmunds the fall was 273 per cent., at Launceston 271 per cent., and at Tenterden 258 per cent. of the average. The London rainfall at Camden Square was 208 per cent. of the average. Generally over England and Wales the fall was 193 per cent. of the average, in Scotland 150 per cent., in Ireland 160 per cent., and for the British Isles as a whole 170 per cent. The duration of rainfall in London was 90·9 hours, which is 51·9 hours above the average of the previous thirty-five years, and the greatest duration in February since records commenced in 1881. A map is given showing the Thames Valley rainfall, and from this it is seen how excessive the rains were. In Hampshire there is a considerable area with more than 6 in., and a large portion of the map shows the rainfall to have exceeded 5 in.

PART 5 of vol. iv. of the Science Reports of the University of Sendai, Japan, contains a paper on the daily variation of underground temperature by Mr. S. Satô, which shows the untrustworthiness of placing the recording thermometer in an iron pipe.

Mr. Satô used both mercury and platinum resistance thermometers in his pipes, and compared their records with those of similar thermometers placed directly in the ground at the same heights. He finds that the records of the thermometers in the pipes differ both in amplitude and in phase from those of the thermometers in the ground, and that the difference is due to the heat conductivity of the material of the pipe and to the convection currents in the air in the pipe. It persists when a poor heat conductor is substituted for iron and when the depth of the pipe is increased. As a result, almost all the values of the thermometric conductivity of soils deduced from observations of temperatures in pipes are too high.

Since the outbreak of the war it has been impossible to obtain the magnetite anodes which have played so important a part in electro-chemical industry, as all these were made in Germany. A note is contained in the *Chemical Trade Journal* of March 4 on the introduction of a substitute for these in the form of "duriron" anodes, made of an iron silicon alloy. Whilst this material is not entirely unacted on when used as an anode in copper sulphate solution, from fifteen to twenty times its weight of copper can be deposited before it is entirely corroded away. Duriron anodes have a higher mechanical strength than magnetite, but require about 13 per cent. more electrical energy to deposit the same quantity of copper. The extra power goes into heat, and special precautions have to be taken to avoid too high a rise in temperature.

A bold article by Mr. C. A. Jacobson on the need for a large Government institution for chemical research, which appeared in the *Journal of Industrial and Engineering Chemistry,* is reprinted in the *Chemical News* (vol. xliii, p. 101). The scheme outlined involves the creation of an institute of chemical research on a colossal scale, consisting of fifty major departments and one hundred minor departments, comprising about fifty buildings, a staff of 1350 trained workers, and an expenditure of more than a million pounds sterling per annum. A few years back such an idea would have sounded utterly utopian and impossible, but, in face of a war expenditure in this country alone every day of five times the amount called for each year by such a scheme, the outlay seems small if thereby supremacy were ensured "in a branch of science which is not only vital to constructive agencies, but even more so to destructive ones. The present European war teaches us that men and military training are of far less importance to success than a high development of the science of chemistry."

A recent issue of *The Engineer* (March 24) contains an account of the Medlow Dam, situated in a sandstone gorge on Adams Creek in the Blue Mountains of New South Wales. The dam is remarkable for its slender profile, having a base width of only 8·96 ft., tapering to 3·5 feet at a height of 29 ft., from which level the thickness remains unaltered to the coping at a height of 65 ft. The wall is of plain concrete, without reinforcement. Our contemporary compares it with the old Bear Valley Dam in California, which, with practically the same height, had a base width of 20 ft., and was generally much more substantial in design. The Medlow Dam is built to a curve of 60 ft. radius, and cost 2762*l*. The catchment area is 1150 acres, with an average rainfall of 39 in. The dam holds up a lake having a surface of 12 acres and containing 67 million gallons of water. By means of an inclined and adjustable off-let pipe the water is drawn off from the clearest stratum at the top.

The National Physical Laboratory has issued some notes on the production and testing of screw gauges, written by members of the staff of the laborator and based on their experience. The Whitwort thread has seven elements, error on any one of whic may be sufficient to cause a gauge to reject wor which ought to pass, or *vice versâ.* These element are: Full diameter, core diameter, effective diamete pitch, angle, form at crest, form at root. Of thes the most important, and the most difficult to con trol, are the pitch and effective diameter. The labora tory is issuing specially selected needles for use wit the micrometer in testing the effective diameters c screws of 12, 14, 24, and 36 threads per inch. Th methods of using these, together with special arrange ments for holding the micrometer in the lathe, ar described in the pamphlet. Triangular needles ar used for testing the core diameter. There is als described an ingenious and cheap apparatus for testin the angle of the thread; this apparatus can be pu together very easily in any workshop. The best wa of obtaining correct pitches is to cut a screw in th lathe, using that part of the leading screw which i to be used in cutting the gauges, and to have it pitch measured from thread to thread at the labora tory. The pamphlet contains a great deal of usefu information, and should be read by everyone inter ested in accurate screw cutting.

Prof. Karl Pearson, Galton Laboratory, Univer sity College, London, W.C., informs us that he ha lately completed the corrigenda for his "Tables fo Statisticians and Biometricians," published by th Cambridge University Press, and that the list is no bound with all exemplars of the tables. He wishe it to be known that previous purchasers of the worl can obtain a copy of the corrigenda by sending request for the same with a stamped envelope to Mr C. F. Clay, Cambridge Press Warhouse, Fetter Lane or to the secretary, Galton Laboratory, Universit College, London, W.C.

The following additional volumes have bee arranged for, for inclusion in the "Fauna of Britisl India" series (Taylor and Francis):—*Lycaenidae* an *Hesperiidae,* H. H. Druce; the *Curculionidae* G. A. K. Marshall; the *Longicorn Beetles,* C. J Gahan; the *Ixodidae* and *Argasidae,* C. Warburton *Leeches,* W. A. Harding; the *Brachyurous Crustacea* Lieut.-Col. A. Alcock; the *Apterygota, Termitidae* and *Embiidae,* A. D. Imms; the *Diptera Brachycera* E. Brunetti; the *Rutelidae,* G. J. Arrow; and th *Operculata,* by G. K. Gude.

Mr. Francis Edwards, 83 High Street, Marylebone London, W., has issued a catalogue of Oriental book he is offering for sale. The works deal with the follow ing among other countries of the Far East:—China Japan, India, Burma, Tibet, and Persia.

OUR ASTRONOMICAL COLUMN.

Comet 1916*a* (Neujmin).—Copenhagen Postcar No. 12 gives an elliptic orbit for this comet, calcu lated by M. J. Braae, from observations covering nin days:—

Epoch, 1916, *January* 0·5, *G.M.T.* M_0 348° 50′ 21·2″

$$\left.\begin{array}{l} \omega = 193^\circ\ 16'\ 2{\cdot}0'' \\ \Omega = 327\ \ 20\ \ 4{\cdot}0 \\ i = 11\ \ 5\ \ 34{\cdot}3 \end{array}\right\} 1916{\cdot}0 \qquad \begin{array}{l} \phi = 36^\circ\ 44'\ 33{\cdot}2'' \\ \mu = 571{\cdot}493 \\ \text{Log } a = 0{\cdot}528664 \end{array}$$

Period, 2267·74 days (6·21 years).

Perihelion passage, 1916, March 10·805 G.M.T.

The ephemeris calculated by Messrs. J. Braae an J. Fischer-Petersen from these elements is given i the following summary:—

From April 6, Greenwich midnight.

R.A., 9h. 36m. 7s., add for April 8, +3m. 31s

'or the successive intervals of two days the second ifferences are: +7, 4, 7, 4, 6, and 3 seconds.

Declination, −3 12·3, add for April 8, −41·1′. uccessive second differences: +1·2′, 1·2′, 1·4′, 1·3′, ·9′, and 1·5′.

The comet will pass near the "bright" nebula, .G.C. 2974, on April 7, and N.G.C. 3115 on pril 20. At the Hill Observatory on April 3 the omet was seen near the calculated position. 'ith the 10-in. refractor, it showed a faint, diffuse, omewhat oval, coma, with a condensation north-receding.

Solar Variation.—The annual report of the Smithonian Astrophysical Observatory for the year 1915 ontains some interesting statements regarding the ariation of solar radiation. The Smithsonian easures of the solar constant have brought to light long-period variation synchronising with sun-spot ctivity, and also rapid irregular fluctuations. Both pes of variability are correlated with a variation of e contrast between the centre and limb of the sun's sc, but in opposite directions. In the first type of ariation high solar constant values and increased ontrast are associated with increased spot activity; the second case the higher solar constant values e associated with diminished contrast. Correspondgly, two distinct causes are suggested: the longriod variation may result from changes of the sun's lective temperature, whilst changes in the transarency of the outer solar envelopes may account for e rapid fluctuations.

The Translational Motion of Binary Stars.—M. . Luplau-Janssen has investigated the distribution of e proper-motion vectors, freed from the effect of the lar movement, of a number of double stars, with ference to their orbital planes (*Astronomische Nachchten*, No. 4828). After rejecting five pairs of small clination (i<30°), data for twenty-nine well-estabshed orbits remain. The proper motions were taken om Boss, and reduced uniformly to their equivalents a distance of 1 parsec. At this distance the adopted lar motion is represented by an angular displacement 4·11″ per year. The resultant proper motions and e node-lines lie in a common plane. It is found that e included angle shows no tendency to take a value out 90°, as it would if the proper motion showed y general parallelism to the normals to the orbits. rther, on resolving the proper motions along rectgular axes, one coincident with the line of nodes, e sums of the components are found to be equal; us there is no tendency apparent for the proper otions to be parallel to the plane of the orbits. A ance distribution is indicated.

The investigation depends on the assumption that e real parallaxes are on the average equal to twice hypothetical minima; measured parallaxes have t been used. M. Luplau-Janssen is convinced of the bstantial accuracy of the fundamental assumption by e result obtained in a determination of the solar otion from the proper motions of 180 double stars by method of Bravais. The deduced solar velocity is ven as 17·1 km./sec. This value is in good accord th that generally accepted, and also with the value ·9 km./sec.) obtained by Weersma by the same thod but from quite different data.

UCATION AND INDUSTRY IN FRANCE.

N extremely interesting account of the rise and growth of industrial education in France appears the *Revue Générale des Sciences*, March 15, contrited by Prof. M. E. Bertrand, of the Ecole d'Arts-ettiers d'Angers. Whilst full of confidence in a military triumph, he is deeply concerned with the position of French industry, especially from the point of view of the adequate scientific and technical training of all who are engaged in it, whether apprentices and workmen or foremen and directors, and urges that it is the imperative duty of the nation to ensure also a victory in the economic sphere. Much space is given to the measures taken from the earliest times for the satisfactory training of those engaged in industry, and the rise and progress of the craft guilds down to their decay on the birth of the factory system is interestingly portrayed. The advent of the Third Republic resulted in active measures for the establishment and support of different types of schools designed to secure the effective training of those destined for industry and commerce, and many excellent mono-technic schools were established, the fine work of which made a magnificent display at the Centennial Exhibition of 1900. Yet with all the variety of effort made for the due training of French youth, it would appear that out of 600,000 young people employed in industry and commerce from thirteen to eighteen years of age, only 30,000 frequent technical schools; whilst 65,000 beyond that age give a more or less assiduous attendance at evening adult courses, as compared with 500,000 under the same conditions in Germany; and where France spends seven million francs on this form of technical education, Germany spends thirty millions from Imperial sources alone. The grave moral danger attending this neglect of training is emphasised by the fact that there are 1,600,000 unemployed young people in France wandering about the public places exposed to serious temptations. Even though Germany is engaged in a devastating war, she is still thinking of the future, and is even now taking energetic measures to conserve her industries so as to secure and advance her economic interests on its conclusion. The article calls upon France to be up and doing, since delay is dangerous, and the economic industrial position of the nation is put in grave peril. A highly appreciative account is given of the educational provision made throughout Germany for the due training of all ranks engaged in productive industry, and much emphasis is laid upon the great value of the continuation schools, which ensure compulsorily the attendance, within the usual hours of employment, until eighteen years of age of all those who have left the day schools. The article contains much of the highest interest to English readers in the present crisis, since the conditions and the aims to be accomplished are much the same in the two allied nations.

THE CORROSION OF CONDENSER TUBES.

THE annual meeting of the Institute of Metals was held on March 29, when the society took leave of its retiring president, Sir Henry Oram, and listened to the address of his successor, Dr. G. T. Beilby. The latter reviewed briefly the unsatisfactory position of certain non-ferrous metal industries in this country, and then indulged in some interesting speculations as to the possibility of preparing lighter alloys, especially for aircraft, than have hitherto been produced. This address has not as yet been printed. When it has been published it will be found to repay very careful study.

The Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research has made a substantial grant to the institute for the purpose of aiding its Corrosion Committee in their investigation of the corrosion of condenser tubes. The publication of the third report to this committee by three investigators, Messrs. Gibbs, Smith, and Ben-

gough, was therefore very timely, and the discussion of this paper occupied the greater part of the proceedings of the meeting. It was followed by a paper by Mr. Elliott Cumberland, who gave a demonstration of his method of minimising the corrosion of condenser tubes, which created considerable interest.

The ground covered in the report to the Corrosion Committee is very extensive, and it is only possible within the limits of this article to give a brief summary of its most salient features. Five alloys have been subjected to corrosion tests under a great variety of conditions. Of these one was ordinary condenser tube metal (70:30 brass), another was Admiralty brass, containing 1 per cent. of tin, and another a special lead brass (2 per cent. of lead). The fourth was a bronze, containing 3·5 per cent. of tin and a trace of phosphorus, and the fifth a copper-aluminium alloy containing 8 per cent. of aluminium. These have been tested in (*a*) stagnant sea-water over the temperature range 15°–60° C.; (*b*) in diluted sea-water of various degrees of dilution and with both gentle and violent aeration. The influence of their surface condition has been carefully examined, the effect of air bubbles adhering to the metal, and that of the E.M.F. due to unequal temperature distribution. Two main types of corrosion have to be considered:—(*a*) *Complete,* in which all the constituents of the alloy dissolve simultaneously at approximately the same rate and uniformly over its surface; (*b*) *selective,* in which one constituent dissolves preferentially. In brass alloys it is usually zinc, and the process is called dezincification. This type of corrosion, however, may conveniently be subdivided into "*general,*" which occurs over the whole surface uniformly, and "*localised,*" which occurs in spots. Selective localised corrosion is the type which is responsible for the chief failures in practice, giving rise as it does to "pitting," which is the most frequent cause of failure.

The authors have come to the conclusion that it is the formation of oxy-salts and their adherence to the surface of the alloy which is the prime cause of pitting, and in spite of the fact that the bronze came worst out of the majority of the tests, when the results were expressed in the form of loss of weight per unit of area, they have concluded that it would be the most likely to give the best results in practice, because its corrosion is of the "complete" type, and no oxy-salt is formed until a temperature of 60° C. is exceeded. No one alloy was found to be satisfactory under all conditions, but much the most resistant alloy under the majority of conditions was that composed of copper and aluminium.

The authors' recommendations as to the minimising of corrosion in condenser tubes are:—(1) The temperature of the water should be kept as low as possible; (2) its flow should be made smooth, foaming and churning being avoided; (3) oxy-salts should be removed as soon as possible after formation.

H. C. H. CARPENTER.

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

THE Estimates for Civil Services for the year ending March 31, 1917, are being issued as Parliamentary Papers. Under Class IV. are included the estimates of expenditure on Education, Science, and Art; and we record below the main points of these estimates, with details of those relating to scientific investigation and higher education.

It will be noticed that the grant in aid of scientific and industrial research has been increased from 25,000*l.* to 40,000*l.*

United Kingdom and England.

BOARD OF EDUCATION.

	1916–17	1915–16
Administration	203,667	209,551
Inspection and examination	222,578	252,458
Public elementary schools etc.	12,640,528	12,696,815
Training of teachers ...	408,282	577,000
Secondary schools and pupil teachers and bursars, etc.	919,800	863,050
Technical schools, etc. ...	576,000	638,000
Scholarships, exhibitions, and other allowances to students, prizes, etc. ...	19,110	30,160
University institutions in respect of technological work...	60,000	59,000
Assistance in choice of employment	4,000	4,500
Imperial College of Science and Technology	30,000	30,000
Chelsea Physic Garden ...	150	150
Royal College of Art ...	8,494	10,300
Victoria and Albert Museum	63,375	70,459
Science Museum	13,943	18,892
Geological Museum	3,212	3,805
Geological Survey of Great Britain	14,718	16,820
Bethnal Green Museum ...	2,735	5,433
Deduct—		
Appropriations in aid ...	3,860	5,015
Net total	£15,186,732	£15,481,378

BRITISH MUSEUM.

British Museum [1]	93,263	110,102
Natural History Museum ...	43,631	51,943
Gross total	136,894	162,045
Deduct—		
Appropriations in aid ...	8,295	13,400
Net total	£128,599	£148,645

SCIENTIFIC INVESTIGATION, ETC.

Royal Society:		
(i) (*a*) Scientific investigations undertaken with the sanction of a committee appointed for the purpose (4,000*l.*), and (*b*) scientific publications (1,000*l.*)	5,000	5,000
(ii) Magnetic Observatory at Eskdalemuir	1,000	1,000
(iii) National Physical Laboratory	7,000	7,000
(iv) Aeronautical Section of the National Physical Laboratory	10,400	9,425
Total for Royal Society	£23,400	£22,425
Meteorological Office ...	22,500	22,500
Royal Geographical Society [2]	1,250	1,250
Royal Academy of Music ...	——	500
Royal College of Music ...	——	500
Marine Biological Association of the United Kingdom	500	500

[1] The British Museum (Bloomsbury) (except the Reading Room, etc.) and part of the Natural History Museum, South Kensington, are closed during the war.

[2] A condition of the Grant is that the Society exhibits to the public, free of charge, its collection of maps.

	1916–17	1915–16
Royal Society of Edinburgh	600	600
Scottish Meteorological Society	100	100
Royal Irish Academy ...	1,600	1,600
Royal Irish Academy of Music	300	300
Royal Zoological Society of Ireland	500	500
Royal Hibernian Academy...	300	300
British School at Athens ...	500	500
British School at Rome ...	500	500
Royal Scottish Geographical Society	200	200
National Library of Wales ...	3,200	3,200
Special Building Grant ...	——	5,000
	3,200	8,200
National Museum of Wales...	2,500	2,500
Special Building Grant ...	14,800	14,800
	17,300	17,300
Solar Physics Observatory ...	3,000	3,000
British Academy	——	400
School of Oriental Studies ...	3,000	1,500
North Sea Fisheries investigation	1,250	1,250
Imperial Transantarctic Expedition, 1914–15	——	5,000
Edinburgh Observatory ...	1,671	1,657
Scientific and Industrial Research:		
Grants to be distributed to institutions or persons in the United Kingdom by a Committee of the Privy Council, with the assistance of an Advisory Council, to promote the development of scientific research, especially in its application to trade and industry, and administrative expenditure in connection therewith	40,000	25,000
Total	£121,671	£115,582

UNIVERSITIES AND COLLEGES.

Universities and Colleges, Great Britain.

	1916–17	1915–16
University of London ...	8,000	8,000
Victoria University of Manchester	2,000	2,000
University of Birmingham	2,000	2,000
University of Wales ...	4,000	4,000
University of Liverpool ...	2,000	2,000
Leeds University	2,000	2,000
Sheffield University	2,000	2,000
Bristol University	2,000	2,000
Durham University	2,000	2,000
Scottish universities, grant in aid under section 25 of the Universities (Scotland), Act, 1889,[3] £42,000; Additional grant in aid £42,000	84,000	84,000
Grants in aid of certain colleges in Great Britain giving education of a university standard in arts and sciences	150,000	150,000
University colleges of North Wales, South Wales and Monmouthshire, and Aberystwyth (£4,000 to each)	12,000	12,000
Additional grant in aid of the expenses of the University of Wales and of the University colleges of North Wales, South Wales and Monmouthshire, and Aberyswyth (2,500l., 5,125l., 7,750l., and 5,125l. respectively) ...	20,500	15,000
Total for universities and colleges ...	£292,500	£287,000

[3] In addition to an annual sum of £30,000 payable to these Universities from the Local Taxation (Scotland) Account under section 2 (2) of the Education and Local Taxation Account (Scotland) Act, 1892.

Intermediate Education, Wales.

	1916–17	1915–16
Examination and inspection	1,200	1,200
Schools	27,500	28,000
Total (Wales)... ...	£28,700	£29,200
Grand total	£321,200	£316,200

Scotland.

PUBLIC EDUCATION.

	1916–17	1915–16
Administration	28,969	28,935
Inspection	43,123	44,290
Elementary schools	2,073,489	2,081,435
Continuation classes and secondary schools	241,000	247,500
Royal Scottish Museum, Edinburgh	10,610	12,832
Training of Teachers ...	145,986	193,389
Examination of accounts ...	1,565	1,524
Total	£2,544,742	£2,609,905

Ireland.

PUBLIC EDUCATION.

	1916–17	1915–16
Administration	30,004	29,526
Inspection	48,901	49,932
Training colleges	64,866	65,120
Model schools	3,861	3,861
National Schools	1,587,250	1,582,000
Manual and practical instruction	12,238	12,580
Teachers' residences ...	6,800	6,800
Superannuation, etc., of teachers (grants in aid) ...	59,484	56,800
Gross total	£1,813,404	£1,806,619
Deduct—		
Appropriations in aid ...	700	700
Net total	£1,812,704	£1,805,919

INTERMEDIATE EDUCATION.

	1916–17	1915–16
Towards salaries of teachers, including cost of administration	40,000	40,000
Endowed Schools Commissioners	905	900

	1916–17	1915–16
SCIENCE AND ART.		
Institutions of science and art	49,224	50,136
Schools of science and art, etc.	99,350	94,950
Geological Survey	1,749	2,171
Examinations in courses of instruction conducted in technical schools	750	850
Gross total	£151,073	£148,107
Deduct—		
Appropriations in aid ...	1,620	1,820
Net total	£149,453	£146,287
UNIVERSITIES AND COLLEGES.		
Grants—		
Queen's University of Belfast	18,000	18,000
University College, Dublin...	32,000	32,000
University College, Cork ...	20,000	20,000
University College, Galway	12,000	12,000
Grants—		
National University of Ireland and University College, Dublin	30,000	40,000
Additional grant to University College, Galway ...	2,000	2,000
Total	£114,000	£124,000

SUMMARY.

EDUCATION, SCIENCE, AND ART.

United Kingdom and England.		
Board of Education	15,186,732	15,481,378
British Museum	128,599	148,645
National Gallery	11,489	15,670
National Portrait Gallery ...	3,485	4,993
Wallace Collection	4,591	7,962
London Museum	2,570	5,465
Scientific investigation, etc.	121,671	115,582
Universities and colleges, Great Britain, and intermediate education, Wales	321,200	316,200
Universities, etc., special grants	——	145,000
Scotland.		
Public education	2,544,742	2,609,905
National galleries	4,522	4,878
Ireland.		
Public education	1,812,704	1,805,919
Intermediate education (Ireland)	40,000	40,000
Endowed Schools Commissioners	905	900
National Gallery	1,845	2,165
Science and art	149,453	146,287
Universities and colleges ...	114,000	124,000
Total	£20,448,508	£20,974,949

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A PRIZE fellowship of about 100*l.* is offered by the Federation of University Women for research of direct national value in the present crisis. Candidates must have published original work. Applications will be received during the present month. Full particulars will be furnished, on request, by the honorary secretary of the federation, 28 College Court, Hammersmith.

THE President of the Board of Education will address a meeting to be held at Caxton Hall, Westminster, at 6.30 on Friday, April 14, on the future development of education in relation to science and commerce. Applications for tickets should be addressed to the secretary, Teachers' Registration Council, 47 Bedford Square, W.C.

AT the invitation of the Hon. Rupert Guinness there was an inspection of the new chemical laboratories of University College, London, on Friday last. The building is complete except in a few minor details, but much remains to be done before it can be fully used for the purposes for which it has been designed. To fit up the "William Ramsay Library," provide electric current throughout the building, and equip the important department of physical chemistry, the sum of 14,000*l.* is needed at once; and a further amount of at least 6000*l.* will be required for the development of research work, making 20,000*l.* in all. Of this amount, Sir Ralph C. Foster, Bart., the generous benefactor who had previously given 34,500*l.* towards the cost of the laboratories, has already contributed 5000*l.*, and Dr. R. Messel has given 500*l.* for the installation and equipment of the joint workshop for the departments of chemistry and physics. The provision of such a workshop as common ground for two branches of science, each of which formerly kept within its own compartment, is a sign of the times. Many of the most important advances made in chemical science of late years belong to physical chemistry, and the future rests largely with workers in this joint domain. When the laboratories at University College are properly equipped, the best possible provision will have been made for satisfactory instruction in all branches of chemistry. There will be a technical laboratory in which chemical processes can be tested on a large scale, with a view to their utilisation for manufacturing purposes, and several separate rooms are provided for general chemical research. The sum required to equip all the new laboratories as they ought to be equipped is small in comparison with the national gain which it will ensure. We trust that a few generous benefactors will see that it is speedily forthcoming. Donations should be sent to the Hon. Rupert Guinness, treasurer of the equipment and endowment fund, University College, W.C.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 30.—Sir J. J. Thomson, president, in the chair.—Prof. W. J. **Sollas**: Skull of Ichthyosaurus, studied in serial sections. The anatomy of the palate, including the form and disposition of the vomer, is described; there is no transverse bone. The parietal is split into two wings, an inner, which contributes to the roof of the cranial cavity, and an outer, which unites with the post-frontal and pre-frontal to form a part of the orbital arch. This feature and the separate opisthotic recall the Chelonia. The columella cranii is an important bone which rises from the surface of the pterygoid to meet the descending limb of the parietal. A rather large pre-articular or goniale is present in the lower jaw. The hyobranchial apparatus proves more complicated than had been supposed, and is more akin to the Amphibia than the Reptiles. The relations of the bones in general are also more complicated. The prevalent squamous

utures are remarkable for their excessive overlap, an daptive character met with also in the Cetacea. chthyosaurus, though a true reptile, possesses many haracters in common with the stegocephalous Amhibia, so that a close comparison of the roof of the kull and the palate may be made with Loxomma,) well described by Dr. Watson. But it shares these haracters with the Cotylosaurian reptiles also, and ·om this group it is probably descended. The nature f the material which enters into the composition of ıe Ichthyosaur bones, when these are of a black or eep brown colour, has been investigated, and is found) consist largely of coal. This had already been roved in the case of Coccosteus. As the bones of the 'alæozoic Coccosteus have become converted into stone" coal of the same nature as that furnished by 'alæozoic plants, so the bones of the Mesozoic Ichthyoaurus have been converted into "brown" coal of the ame nature as that furnished by Mesozoic plants.—)orothy J. **Lloyd**: The relation of excised muscle to cids, salts, and bases. (1) Acids and alkalis both ause swelling in excised muscle. The degree of welling is not directly proportional to the concentraon of acid on alkali in the surrounding fluid, but as a maximum at 0·005 normal for hydrochloric acid nd for caustic soda. Alkalis first coagulate and ıen re-dissolve the muscle substance. (2) The hlorides of the alkali and alkaline earth metals all ltimately coagulate the protoplasm of an excised uscle in isotonic solutions. The bivalent kations how this effect much more rapidly than the monoalent. (3) The iso-electric point for muscle is between $P_H=5$ and $P_H=7$. (4) It is suggested that the swellıg and shrinking of muscles, both in the body and ut, is an osmotic phenomenon, and that the state f aggregation of the colloids of the muscle substance the chief determining factor which fixes the degree f swelling. Lillie's demonstration that acids and lkalis raise the osmotic pressure of gelatin, while ıe neutral salts lower it, is in harmony with this view. 5) The osmotic phenomena of muscle can be fully xplained without assuming the presence of a semiermeable membrane round the muscle fibres.—J. C. **Villis**: The endemic flora of Ceylon, with reference) geographical distribution and evolution in general.

Physical Society, March 10.—Prof. C. Vernon Boys, resident, in the chair.—S. **Skinner**: Experiments illusrating the flow of heat in conducting sheets. If a heet of tinned iron be heated locally by means of a Bunsen burner or blowpipe the tin is melted for a ertain distance from the heated region. On allowing he sheet to cool the resolidified tin is separated from he unmelted tin by a very sharp line of demarcation. This line gives the equi-temperature curve correspondng to the melting point of tin. By pushing the heatng to a greater or less extent a series of such equiemperature curves can be obtained for a sheet of any articular shape heated at any given point. The cases hown illustrated the flow of heat into a rectangular late from a heated tongue; into a circular disc from heated tongue; round the corner of an L-shaped trip and into the vanes of an air-cooled cylinder. The esults were shown to be closely analogous to the flow f electricity in similarly shaped conductors.—Dr. R. S. **Willows** and H. T. **George**: The absorption of ases by quartz bulbs. The experiments are a coninuation of those of Willows (*Phil. Mag.*, April, 1901) nd Hill (Phys. Soc., December, 1912) on the absorpion of gas which is brought about by electrical disharges. A new quartz bulb does not absorb air, ut if it be fed with repeated doses of hydrogen—which are absorbed when an electrodeless discharge passed—it then becomes very active. If discharges n hydrogen are alternated with those in air the bulb can be made to absorb large quantities of either gas, and the activity with each gradually increases. The authors reject the theory of surface absorption and, in their own experiments at least, also Swinton's theory that the gas is shot into the walls and held there. It is supposed that chemical actions occur with air, and oxidation products are formed; these are reduced by hydrogen.

Linnean Society, March 16.—Prof. E. B. Poulton, president, in the chair.—C. C. **Lacaita**: Plants collected in Sikkim, including the Kalimpong district, April 8 to May 9, 1913. The author gave an account of his circular journey from Darjiling to his starting point, part of it with the party of H.E. the Governor of Bengal. The monotony of the forest region was mentioned, and the marvellous abundance of the Aroids.

PARIS.

Academy of Sciences, March 20.—M. Paul Appell in the chair.—Pierre **Duhem**: The hypothesis of Faraday and Mossotti, and on certain conditions verified at the contact of two dielectrics.—J. Comas **Solà**: Some remarks on the great nebula in Orion (1976 N.G.C.). The results of stereoscopic observations and photographic comparisons are given, from which it would appear that there is a proper movement of the more brilliant parts of the nebula of the order of 0·025″ per annum. Internal transversal movements of the filaments of the above nebula and also of the nebula H.V. 30, 1977 N.G.C. were also detected with certainty.—T. H. **Gronwall**: A functional equation in the kinetic theory of gases.—M. **Riquier**: Partial systems of the first order to which the Jacobi method of integration applies, and the analytical prolongation of their integrals.—L. **Reutter**: Lacustral ambers. An account of analyses of five pieces of amber of well-authenticated origin, three from the Baltic, two from Italy. Clear differences could be detected between the German and Italian ambers.—N. **Arabu**: The existence of the Hipparion fauna in the Sarmatian of the basin of the Sea of Marmora and its consequences for the classification of the Neogene in south-eastern Europe.—Maurice **Lugeon**: The rose coloration of certain rocks of the massif of the Aiguilles Rouges. The coloration is shown to be due to iron and its peculiarities are described. A theory of the cause of its origin is proposed.—Ph. **Glangeaud**: The Pavin crater lake and the volcano of Montchalm, Puy-de-Dôme.—Mlle. Yvonne **Dehorne**: A milleporoid Stromatopore of the Portlandian.—Henri **Fouqué**: The ferments of pineapple wine. Of four yeasts isolated, two were certainly Saccharomyces, and two were doubtful yeasts between Mycoderma and Torula.—E. **Demoussy**: The influence of hydrogen peroxide on germination. Old seeds, which may have preserved their germinating power, may fail to germinate under conditions favourable to the growth of young seeds if these conditions are more favourable to the development of parasitic micro-organisms requiring oxygen for their growth. In the presence of dilute solutions of hydrogen peroxide a considerable proportion of such seeds will germinate. A result of practical importance follows from this, that tests of germinating power carried out under laboratory conditions may lead to seeds being regarded as bad, whilst the same seed, grown in the soil, may prove to be of average quality. This conclusion is confirmed by results obtained in practice with seeds of beetroot.—V. **Ferrand**: A modification of the method for the sterilisation of drinking water by sodium hypochlorite. Hydrogen peroxide is proposed for the removal of the excess of hypochlorite instead of the commonly used sodium thiosulphate. There is a saving of time in the sterilisation.—MM. **Dalimier** and **Lévy-Franckel**: The

102 of Danysz in the treatment of malignant or grave syphilis. Cases which followed the ordinary course are not dealt with in the present paper, which is concerned with twenty-two cases of abnormal, or particularly severe syphilis. The results are strongly in favour of the treatment.—E. **Bataillon**: New experiments on the fecondation membrane in the eggs of Amphibia.

BOOKS RECEIVED.

Our Cottage and a Motor. By W. Moncreiff. Pp. 163. (London: G. Allen and Unwin, Ltd.) 3*s*. 6*d*. net.

Meteorites: their Structure, Composition, and Terrestrial Relations. By Dr. O. C. Farrington. Pp. x+233. (Chicago: The author). 2 dollars.

Rambles of a Canadian Naturalist. By S. T. Wood. Pp. vii+247. (London: J. M. Dent and Sons, Ltd.) 6*s*. net.

The Germans. By Rt. Hon. J. M. Robertson. Pp. viii+291. (London: Williams and Norgate.) 7*s*. 6*d*. net.

Women and the Land. By Viscountess Wolseley. Pp. xi+230. (London: Chatto and Windus.) 5*s*. net.

Report for 1915 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. W. A. Herdman. No. xxiv. Pp. 62. (Liverpool: C. Tinling and Co.)

Cambridge Tracts in Mathematics and Mathematical Physics. No. 2: The Integration of Functions of a Single Variable. By G. H. Hardy. Second edition. Pp. viii+67. (Cambridge: At the University Press.) 3*s*. net.

Hydrodynamics. By Prof. H. Lamb. Fourth edition. Pp. xvi+708. (Cambridge: At the University Press.) 24*s*. net.

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol. v. By R. Lydekker. Pp. xlv+207. (London: Longmans and Co., and others.) 7*s*. 6*d*.

British Museum (Natural History). Report on Cetacea stranded on the British Coasts during 1915. By Dr. Harmer. Pp. 12. (London.) 1*s*. 6*d*.

The Involuntary Nervous System. By Dr. W. H. Gaskell. Pp. ix+178. (London: Longmans and Co.) 6*s*. net.

The Deposits of the Useful Minerals and Rocks: their Origin, Form, and Content. By Profs. F. Beyschlag, J. H. L. Vogt, and P. Krusch. Translated by S. J. Truscott. Vol. ii. Pp. xxi+515–1262. (London: Macmillan and Co., Ltd.) 20*s*. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.—The Instability of the Pear-shaped Figure of Equilibrium of a Rotating Mass of Liquid: J. H. Jeans.—A Hypothesis of Molecular Configuration in Three Dimensions of Space: Sir William Ramsay.—The Motion of Solids in a Liquid Possessing Vorticity: J. Proudman.—The Occurrence of Gelatinous Spicules and their Mode of Origin in a New Genus of Siliceous Sponges: Prof. A. Dendy.—The Ultra-Violet Absorption Spectra of Blood Sera: Dr. S. J. Lewis.

LINNEAN SOCIETY, at 5.—On Five New Species of Edwardsia, Quatr.: Prof. G. C. Bourne.—A New Species of Enteropneusta from the Abrolhos Islands: Prof. W. J. Dakin.—The Southern Elements of the British Flora: Dr. O. Stapf.

FARADAY SOCIETY, at 8.—The Making of a Big Gun: Dr. W. Rosenhain.

FRIDAY, APRIL 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Notes on the Corallian of the Oxford District: M. Odling.—The Glacial Geology of the Hudson Bay Basin: J. B. Tyrrell.

SATURDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

MONDAY, APRIL 10.

ROYAL SOCIETY OF ARTS, at 4.30.—Surveying: Past and Present: E. A. Reeves.

ARISTOTELIAN SOCIETY, at 8.—Parmenides, Zeno, and Socrates: Prof. A. E. Taylor.

TUESDAY, APRIL 11.

ROYAL INSTITUTION, at 3.—Modern Horticulture—Old and New Methods of Forcing (The Breaking of Rhythm): Prof. F. Keeble.

ROYAL SOCIETY OF ARTS, at 4.30.—The Forest Resources of Newfoundland: Sir Daniel Morris.

WEDNESDAY, APRIL 12.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—President's Address.—The Work of the Load Line Committee: Sir Philip Watts.—Some Questions in Connection with the Work of the Load Line Committee: W. S. Abell. At 3.—The Laws of Skin Friction of a Fluid in Stream Line and in Turbulent Motion along a Solid of Great Length: Dr. C. H. Lees.—Skin Friction Resistance of Ships and our Useful Knowledge of the Subject: G. S. Baker.—Experiments to Determine the Resistance of Bilge-keels to Rolling: Prof. T. B. Abell.—An Experimental Tank Reproducing Wave Motion: Col. G. Russo. At 7.30.—A Brief Summary of the Present Position of the Marine Diesel Engine and its Possibilities: Eng.-Lieut. W. P. Sillince.—The Co-ordination of Propeller Results: J. D. Young.—Note on Maximum Propulsive Efficiency of Screw Propellers: T. C. Tobin.

THURSDAY, APRIL 13.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Discussion*: The Present Position of Electricity Supply in the United Kingdom; and the Steps to be taken to Improve and Strengthen it.

CHILD STUDY SOCIETY, at 6.—Experiments on Hand-writing in Schools: Dr. C. W. Kimmins, Mrs. Grainger, and Miss Golds. At 7.30.—Annual Meeting.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Subdivision of Merchant Vessels: Reports of the Bulkhead Committee, 1912–1915: Sir Archibald Denny.—Strength of Watertight Bulkheads: J. F. King.—Some Effects of the Bulkhead Committee's Reports in Practice: A. T. Wall. At 3.—Notes from a Collision Case: J. Reid.—Shipyard Cranes of the Rotterdam Dockyard Company: M. G. de Gelder.

FRIDAY, APRIL 14.

ROYAL INSTITUTION, at 5.30.—The Genesis and Absorption of X-Rays: Sir J. J. Thomson.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Theory and Practice in the Filtration of Water: W. Clemence.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

OPTICAL SOCIETY, at 8.—Practical Workshop and Laboratory Measurements: S. D. Chalmers.—Some Further Notes on Focometry: T. F. Connolly.

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THURSDAY, APRIL 13, 1916.

IRRADIATION: ITS PHYSIOLOGY, PATHOLOGY, AND THERAPEUTICS.

Radium, X-Rays, and the Living Cell. With Physical Introduction. By H. A. Colwell and Dr. S. Russ. Pp. x+324. (London: G. Bell and Sons, Ltd., 1915.) Price *12s. 6d.* net.

THE authors' object is "to describe some of the main experimental facts which have been established as to the effects of the X-rays and the rays from radium upon living cells." The first part of the book is devoted to physics, and contains a trustworthy account of the properties of the X-rays, primary and secondary, and of the radio-active substances, with the characters of the various forms of radiation and the changes brought about by their action. The measurement of ionisation is described, the distinction between "hard" and "soft" rays—recognised clinically by all radiologists—is explained on physical lines, and the methods of measuring doses of X-rays are discussed. The empirical method of Sabouraud of judging the dose by the change of colour of a pastille is still in vogue, and those who use the method are aware that they must keep all the conditions constant (state of vacuum of the tube, length of the parallel spark gap, reading of the milliamperemetre, etc.); the authors are wise, however, to point out anew that the same change of colour, if produced by soft rays in one case and by hard rays in another, may give rise to results widely different in the two cases.

In describing the characters of radium emanation, the use of the "Emanatoria" is discussed. These institutions are founded on the fact that radium emanation, when breathed mixed with air, gradually makes its way into the circulation by solution and diffusion, and so reaches all the tissues of the body. The air of the Emanatorium is breathed for two or three hours at a time, and it is found that a state of equilibrium is reached in half an hour, while nearly all the emanation (90 per cent.) has disappeared from the system one hour after removal into fresh air. The emanation, while circulating in the body, is continually forming the active deposit, which is not lost by way of the lungs as is the case with the emanation. These Emanatoria have been extolled for the "scientific" treatment of gout, on the principle (capable of laboratory demonstration) that the insoluble monosodium urate can be broken up by radium D into several simpler bodies, which are eliminated as carbon dioxide and ammonia. The authors point out, however, that the concentration of the emanation in the blood in patients subjected to Emanatorium treatment never reaches more than one ten-millionth of that used in the laboratory experiments; hence it seems unlikely that any appreciable decomposition of monosodium urate can take place in the blood.

Globulin solutions are used in experiments to show that α radiation may produce results differing in degree and in kind from those due to β and γ rays.

The effects of the irradiation of bacteria is discussed with the aid of conclusive experiments, and it is shown that a bactericidal result can be attained, though the dose required is a very strong one from a clinical point of view. In local conditions a solution of radium emanation might be useful, but the choice of a solvent is important, and most of the fluids having high coefficients of absorption cannot be used for injection into the body. Liquid paraffin is the most suitable solvent; its coefficient of absorption is high, and its viscosity keeps it at the site of injection.

The changes produced in the skin by irradiation are only too well known to those who were pioneers in the clinical use of the X-rays. The histological changes are described in detail, and illustrated by photomicrographs. These changes are both atrophic and hypertrophic, and the latter tend to culminate in cancer.

The blood changes are of great interest, and in certain blood diseases a very favourable result is produced by irradiation. This is notably true of leukæmia, a disease in which the white cells are enormously increased in number, while many of them are abnormal in type. The red cells are decreased in number. The result of X-ray treatment is to restore the blood more and more nearly to a normal state, both qualitatively and quantitatively

Of special interest to the medical profession, and also to the public, is the discussion of the effect of irradiation of cancerous cells. This subject receives full attention, an account of the results on experimental cancers (*e.g.* in mice) being followed by a description of those on spontaneous cancers in man and in the lower animals. It is found that young, actively-dividing cancer cells are most susceptible to irradiation, and that in some of these cases (especially in the grafted cancers of mice), while a large tumour may disappear rapidly, its destruction may cause the death of the animal by the toxins evolved during the disintegration of the mass.

Another aspect of the cancer question is the converse one, of the way cancerous change may be produced in healthy tissues by repeated small doses of soft X-rays. This topic has been touched upon already in the case of the hands of radiologists.

The question of idiosyncrasy is a difficult one, and radiologists of repute differ, even now, as to whether cases of real hypersensitiveness to X-rays exist. Every careful radiologist of experience will, we believe, agree with the authors that the same dose does not produce exactly the same effect in different persons, or even in the same person at different times. Another point is made by the authors when they show that a large dose acting for a short time is not equivalent to a small dose acting for a long time.

The book closes with a short but lucid chapter on the selective and differential action of the rays. In the case of the protozoa, it is shown that a

wide variation exists in their response to the same exposure. An absence of chlorophyll makes for increased sensitiveness, and the multi-nucleated forms suffer more than the mono-nucleated, and the large forms more than the small. In the testicle the rays show an essentially selective action, the seminiferous epithelium being destroyed by a dose to which the cells of Sertoli are indifferent. Certain tissues are highly sensitive to the X-rays—notably lymphoid tissue, cartilage, and the endothelium of blood-vessels. Within limits it is true to say that very rapidly growing cells are most affected by irradiation. But it is important to note that different rays give rise to different effects upon one and the same kind of cell, and "a careful distinction should be made between the differential action which different rays have upon the same variety of cell, and the selective action which the same kind of radiation has upon the many different varieties of cells." The X-ray spectrum covers a range of many octaves of wave-length.

If we consider a single cell, we find it exhibits a widely varying degree of reaction (to irradiation) according to the particular phase of its life cycle in which it happens to be at the time. Thus certain ova are nearly eight times as vulnerable to β-rays when they are in an active state of division as when they are in a resting stage. This fact indicates one of the difficulties of quantitative investigations upon living tissues. The chemical composition of a cell may determine the degree of change brought about by irradiation. In sections of malignant growths cut for the microscope before and after irradiation, the staining reactions point to marked changes in chemical composition, and these go hand in hand with the morphological changes.

The authors have given us a book which cannot fail to appeal to the clinical radiologist and to the laboratory worker. Each chapter has received careful study in the writing, and provides food for thought and suggests scope for further investigation on the part of the reader. The book is well printed in clear type on good paper, and contains many excellent illustrations. There is an index of authors, as well as a full general index.

THE MEDIUM UNDER THE MICROSCOPE.

A Contribution to the Study of the Psychology of Mrs. Piper's Trance Phenomena. By Mrs. Henry Sidgwick. *Proceedings of the Society for Psychical Research.* Part lxxi., vol. xxviii, December, 1915. Pp. xix + 657. (Glasgow: R. Maclehose and Co., Ltd., 1915.) Price 12*s.* net.

William James once referred to Henry Sidgwick as "the most exasperatingly critical mind in England," and the whimsical compliment was well deserved. After the death of the famous professor of moral philosophy, the mantle of the arch-critic fell naturally on the shoulders of one of Sidgwick's most able pupils, Mr. A. J. Balfour, whose "Defence of Philosophic Doubt" was as destructive as we hope our Navy will be under his First Lordship; but now that he has reached a more constructive period, as evidenced by his recent "Theism and Humanism," the pallium passes to his sister, the professor's widow, and late principal of Newnham College. Anyone who is not willing to believe unquestioningly what has successfully passed the ordeal of her scrutiny must be constitutionally unable to believe anything. If she were censor the newspapers would have to cease publication, for she would never believe any but official reports, and probably not them.

In this bulky volume Mrs. Sidgwick discusses the phenomena of the famous Boston medium who has been for twenty-five years almost continuously under the supervision of various eminent scientific men, including Prof. James—who was an M.D. as well as the apostle of Pragmatism—and Sir Oliver Lodge. This lady began to experience sleep-like trances in 1884, but they were only sleep-like so far as concerned Mrs. Piper's normal consciousness, for her tongue talked—or, later, her hand wrote—in a very wideawake fashion. What was there, in place of Mrs. Piper's normal consciousness, which certainly was *not* there, furnishes the theme of Mrs. Sidgwick's discourse. First, ostensibly, came a Dr. Phinuit, a "spirit" who said he had been a doctor in Metz. Investigation failed to trace his earthly career, and his knowledge of French was scanty—seemed, in fact, about like Mrs. Piper's. But the queer thing was that this dubious entity could usually tell sitters quite a lot about their deceased relatives, and he professed to get the information from the relatives themselves, who were with him in the spiritual realms. This kind of thing happened freely, even when the investigators introduced sitters from a distance—people entirely unknown to Mrs. Piper—anonymously or pseudonymously. Then another spirit turned up—George Pelham, a lawyer formerly known to the Society's chief investigator, Dr. Richard Hodgson—who gave any amount of identification evidence about himself, recognising his friends and greeting them by name in astonishingly correct fashion. Later there appeared various characters in early history. Lastly came Hodgson, who had died in 1905; but his evidence is not very weighty, because he was known to Mrs. Piper, and consequently we must assume that any given would-be identification-fact may also have been known to her.

Now what about all these "controls" and "communicators"? What are they, anyhow? Spirits, as they allege, or dream-personalities, fragments of Mrs. Piper's subliminal or hypnotic consciousness? Mrs. Sidgwick thinks the latter; and most people will agree with her rather than weigh all her arguments, which are lengthy and complicated, though the historical part of the book is easy and interesting. She admits, however, that Mrs. Piper's trance utterances contain a great deal of matter which Mrs. Piper has not learnt through the known sensory channels. This dis-

poses of the fraud-theory. Some of this matter may be due to thought-transference ("telepathy") from living people; but in some cases it seems almost necessary to admit telepathy from the so-called dead. Particularly is this the case in regard to George Pelham, whose evidence is given in an earlier volume of "Proceedings"—No. 13.

All investigators admit that the evidence in that volume is impressive, and that the Piper case as a whole is remarkable. It is still more remarkable, perhaps, to find so cautious a mind as Mrs. Sidgwick's accepting communication from the dead as a reasonable hypothesis, even though she does dignify it with the sounding title of telepathy through a personation or subliminal fraction. Certainly the evidence does seem beginning to appear conclusive or almost so. It can no longer be "vanquished with a grin." Perhaps in due time it may become so strong that man's survival of death will be a scientific as well as a religious belief. Meanwhile, such volumes as that under notice are very welcome as showing a *via media* between extremes of credulity and incredulity, which are equally unscientific and regrettable.

J. A. H.

ANALYTICAL AIDS FOR FACTORY CHEMISTS.

Solvents, Oils, Gums, Waxes, and Allied Substances. By F. S. Hyde. Pp. vi + 176. (London: Constable and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

At the moment the factory chemist is very much before the public. The university-trained man complains of the very inadequate reward which he can obtain for his labours. The manufacturer is reported to be dissatisfied with the chemist fresh from the university, and all parties criticise the present methods of training. It might be at least expected that the technical chemist should know chemistry, meaning thereby a full knowledge of the properties, preparation, and manipulation of the commoner substances, both inorganic and organic; that he should understand the spirit of research and how to set about a problem; that he should be versed in getting up the literature. The fact is, such chemists are rare; a real knowledge of chemistry, particularly organic chemistry, is largely neglected. As a consequence special text-books are provided for the use of factory chemists, such as the one before us. It contains in the minimum number of words a short statement as to the properties of a variety of organic substances, and will serve as a useful adjunct to the memory of the properly trained man. In the hands of others it is more likely to mislead, since as a result of the condensation necessary, the information is often scrappy and unequal, and the true spirit of organic chemistry is missing.

For example, the statement that dextrose is less sweet than cane sugar, though true, in no way conveys the proper idea to anyone imperfectly acquainted with the great difference between the two sugars in appearance and in crystalline character. Glucosides are defined as substances which "on fermentation" or by hydrolysis yield glucose. Ethyl alcohol is dismissed in nine lines! Ten pages suffice for the alkaloids and bitter principles.

As a whole, the book is well done; it is full of information, accurate and up-to-date, particularly as regards the sections devoted to oils, fats, and waxes, which occupy more than half the contents. This branch of chemical analysis involves the use of a number of special methods, largely empirical in character, and usually labelled with the names of their proposers, with which the would-be expert must be acquainted. For this purpose he will find Mr. Hyde's book most helpful.

It will be much more to the advantage of the individual worker as well as of the works laboratory, however, if information be sought from the larger manuals of chemistry and the critical faculty in analysis is cultivated, instead of striving more or less mechanically to carry out operations as quickly as possible, by following explicit instructions without any real understanding of the chemistry of the reactions concerned.

ASTRONOMY FOR JUVENILE READERS.

A Voyage in Space: A Course of Six Lectures "Adapted to a Juvenile Auditory" delivered at the Royal Institution at Christmas, 1913. By Prof. H. H. Turner. Pp. xvi + 304. (London: S.P.C.K., 1915.) Price 6*s.* net.

The voyage in space which forms the subject of this book is not a romantic flight of the imagination, such as might have been written by Jules Verne, but an account of a journey by telescope. In other words, it is an elementary book on astronomy, and is founded on a course of lectures to young people at the Royal Institution. Following the example of Faraday on a similar occasion, the author has retained the language of the lecture room, and has thus been able to preserve the freshness of the original presentation. The reader is necessarily deprived of witnessing the actual experiments, and of seeing many of the pictures exhibited by the lantern, but the descriptions are so vivid and the illustrations so numerous that he will readily imagine himself to be a member of the audience.

The difficulty of leaving the earth in the flesh provides the occasion in the first lecture for an account of gravity in its historical, experimental, and astronomical aspects. Then, in the second lecture, the immense distances which have to be traversed before reaching the heavenly bodies are dealt with, and an interesting talk is devoted to our own atmosphere, which must necessarily be passed through during the first part of the voyage. Telescopes, as the only means of travelling to distant spheres, are the subject of the third lecture, and subsequent lectures deal respectively with visits to the moon and planets, to the sun, and to the stars.

Although an astonishingly wide range of subjects is covered by the lectures, the book is not to be regarded as a comprehensive introduction to astronomy. Thus, explanations of everyday phenomena, such as the phases of the moon, the apparent annual motion of the stars, or the appearance of Venus as a morning or evening star, do not come within its scope. On the other hand, the author has not hesitated to introduce such matters as the principles of spectrum analysis, the sun-spot swarm hypothesis, the selenium photometer, the systematic motions of the stars, and the spectroheliograph. But whatever the subject in hand, he is generally successful in making it interesting and easy of comprehension as regards general principles. The treatment is at times unconventional, but never dull or obscure, and the interest throughout is maintained by an abundance of appropriate stories and quaint allusions. The illustrations, of which there are more than 130, are well chosen, and include many which have not previously been seen in text-books, some of them being of marked originality. We cordially recommend the book as being likely to give an intelligent interest in the fascinating investigations of modern astronomy.

OUR BOOKSHELF.

East Lothian. By T. S. Muir. Pp. viii+117. (Cambridge: At the University Press, 1915.) Price 1*s*. 6*d*. net.

EAST LOTHIAN includes representatives of the chief geographical types found in the Scottish lowlands. It has a varied coast, rich plains and high moorland, and its especial geographical feature is its series of volcanic necks, including Berwick Law. The county has played an important part in Scottish history, for in it were fought the battles of Dunbar and Preston Pans, and it was the birthplace of such representative Scots as John Knox, Baird of Corunna, and Moffat. Its coal mines are of historic interest as the oldest on record, and their mediæval labour conditions lasted till little more than a century ago, when the miners were still serfs who were restricted to their native places and whose children had to follow the occupation of their parent. The county is mainly famous for its agriculture, and owing to the exceptional quality of its soils and the scientific skill of its farmers, its crops are perhaps unsurpassed in value. Mr. Muir tells us (p. 58) that 4*l*. to 5*l*. per acre is a common rent, and that the county, though small, contains no fewer than seventeen farms with an annual rent of more than 1000*l*.

This volume of the Cambridge County Primers is fortunate in its author; for Mr. T. S. Muir, who is geographical master at the Edinburgh High School, knows the county well, and describes it in accordance with modern geographical ideas. The work includes summaries of the geology and natural history of the county, but they are treated from their geographical aspects. One of the most interesting sections is on the place names, which are illustrated by a map showing the distribution of those of Gaelic, Pictish, and Teutonic origin. The work is well illustrated by photographs and physical and geological maps. J. W. G.

Theosophy and Modern Thought. By C. Jinarājadāsa. Pp. 171. (Adyar, Madras: Theosophical Publishing House, 1915.) Price 2*s*.

THERE are here four lectures—on theosophy and the problem of heredity; history in the light of reincarnation; the basis of art expression; and the search for reality. Dealing with heredity, the author shows that he has been greatly influenced by Prof. Bateson's Australian address. "The growth from protoplasm to man, and from the savage to the genius, is by a process of *losing* inhibiting factors; and by loss of factors faculties are released." The release of the possibilities of life and growth is guided by intelligences, the Deva Builders, who bring about the evolution of the form side of things by producing changes from the life side in each group-soul.

The second lecture illustrates eloquently the idea that as nations pass away they reincarnate in other parts of the earth—the Phœnicians in the Germans, for instance, and those who said "Carthago est delenda" in those who say "Prussia must go." The third lecture is largely concerned with the doctrine of archetypes, which are striving to express themselves in organic evolution. Every beautiful organism is a window through which man may get a glimpse of an archetype, "a masterpiece of the artist of artists, the Demiourgos of our world." In the fourth lecture Mr. Jinarājadāsa speaks of the many pathways to reality and the spirit which must possess those who would be pilgrims.

Nutritional Physiology. By P. G. Stiles. Pp. 288. (Philadelphia and London: W. B. Saunders Company, 1915.) Price 6*s*. net.

THIS is the second edition of Prof. Stiles's useful manual, the first of which appeared about three years ago. Although its chief object (alimentation, digestion, metabolism) is expressed in the title, other related portions of physiological science, such as the circulation, the ductless glands, and even the nervous system are considered briefly. The main subject is treated from the point of view of energetics, and we can trace throughout the influence exercised by Prof. Graham Lusk, to whom the book is dedicated. Lusk is one of the leading lights across the Atlantic, who have successfully striven to render the subject of metabolism scientifically correct by such a method of treatment. W. D. H.

Our Cottage and a Motor. By Margaret Moncreiff. Pp. 163. (London: George Allen and Unwin, Ltd., 1916.) Price 3*s*. 6*d*. net.

THIS chatty description of a holiday spent in a Sussex cottage, when the days were often spent motoring among the lovely lanes, makes very pleasant reading. We hope the spelling Sir Charles Leyall, on pp. 127 and 128, for the name of the distinguished geologist will be changed in any future edition of the book.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Smithsonian Physical Tables.

THE Smithsonian Institution has just published a new edition of the Smithsonian Physical Tables, corrected and slightly modified from the sixth revised edition. Requests have come from certain educational institutions for separate copies of certain individual tables for the use of students in laboratories. If there is likely to be a considerable demand for such separates, the institution will have them printed on stiff paper and distributed at cost to those who desire them. With the view of ascertaining the probable demand for separate tables, it is requested that readers of NATURE inform the Institution which tables they would desire in separate form, and the number of copies of each they would probably require. All tables for which the probable demand of this kind reaches 100 copies will be reprinted separately.

The tables may be consulted in nearly all the larger libraries.

C. D. WALCOTT,
Secretary.

Smithsonian Institution,
Washington, U.S.A., March 23.

Effect of Tidal Water in an Estuary on the Level of Subterranean Water.

AN artesian well was bored at Portishead last August lined with 8 in. and 10 in. casing, the annular space between the casings being filled with cement, so that the possible ingress of surface waters is avoided.

The well has been in constant use since that date, the water-level standing in the summer about 10 ft. below the surface of the ground, which is only a foot or two above high-water mark. A few days ago pumping from the well was temporarily discontinued. It was noticed that the level fluctuated with the state of the tide. When the tide was out the level of the water was about 4 ft. below the surface; as the tide came in the level of the water gradually rose, until at high tide the well was overflowing.

This behaviour has continued regularly, the rise and fall of level closely corresponding with the rise and fall of the tide.

This affords an excellent example of the weight of the incoming tide water in the Severn estuary, subjecting the underlying strata to pressure and squeezing the water out as if out of a sponge. The water is drawn from strata underlying more than 100 ft. of clayey marl.

JAS. KEWLEY.

Cambrian Lodge, Portishead, March 30.

Is Soap Necessary for Shaving?

AT the present time when economy is the watchword, it may be not altogether a waste of time to ask whether soap is necessary for shaving?

The old Romans and Greeks, as evidenced by the statues, were evidently gentlemen addicted to shaving, but, save for a small soap factory discovered at Pompeii, the means of producing soap in those days must have been very limited.

The only conclusion that one can arrive at is that they must have shaved without soap, a practice that is to the present day indulged in by our Oriental allies, the Japanese, as well as by their neighbours, the Chinese.

Before deciding definitely to discard such a familiar adjunct of the toilet, it might be of interest to inquire why we have been in the habit of using soap for shaving.

The answers to the question received from scientific and unscientific persons are very interesting, culminating in the fascinating one of a barber who thought that the soap propped up the hairs and kept them in an upright position.

Lathering has the effect, when properly done, of reducing the bulk of the soap, and increasing the number of bubbles whereby water is kept in close apposition to the skin by the surface tension.

This is a roundabout way of using water as a lubricant for the efficient and easy passage of the razor across the skin, but once the lubricating qualities of water are recognised as of value in such circumstances it is but a short step to applying the water direct and shaving while the skin is well soused.

This is the method for long in use by the Orientals, and is one that can be thoroughly recommended for trial in this country.

Apart from its economy, the skin is not so liable to irritation, the edge of the razor is not so easily dulled, whilst the whole operation is completed in half the time.

G. ARBOUR STEPHENS.

March 25.

MALARIA AND SANITATION.[1]

THE title of this work is somewhat inappropriate as the book deals scarcely at all with many aspects of rural sanitation, but is devoted in the main to what undoubtedly is a very important problem, viz., malaria prophylaxis. It is also not quite evident for what class of reader the book is intended. The book has none of the characters of a text-book or treatise on sanitation, but gives the impression of being written rather for the intelligent layman—we have, *e.g.*, two and a half pages of extract from Lafcadio Hearn's works—were it not that here and there discussions on technical points are recorded at some length, *e.g.*, the identity of certain species of Anophelines. What the book really consists of for the most part is a diary of various sanitary tours made by the author. The outstanding feature of the book is the author's enthusiasm for his subject, and the best portions, for they are the fullest, are those devoted to the sanitary problems that arose at every step in the making of the Panama Canal and the descriptions as to how these difficulties were overcome. Out of eighteen chapters, nine, and out of fifty-six illustrations, thirty-six, are devoted to the Canal.

To malaria in India, on the contrary, the author gives the inadequate amount of only a dozen pages, and these concern the importance of species in determining the prevalence of malaria, a fact fully recognised in India sixteen years ago, which the author confirms from his own experience in the Malay States. The author's work in reducing malaria in Klang and Port Swettenham is well known, but we do not get a clear idea from this book as to how it was done. We know these places were drained, but we should have liked sketch-maps of breeding-places showing the

[1] "Rural Sanitation in the Tropics." By Dr. M. Watson. Pp. xvi+320 (London: John Murray, 1915.) Price 12s. net.

species of mosquito concerned, the result of the draining on the breeding-places, and generally a fuller account, but perhaps these will be found in another work to which the author refers, and here only the broad outline was intended.

The author in writing is inclined to use rather vague expressions, such as "a long series of blood examinations" (the number is not given), "proved up to the hilt" (sometimes a very dangerous expression, as one could easily show), "quinine in every shape and form" (dose not stated), "a high percentage" of the labourers harbours malaria parasites (figure not given), and his use of figures is not entirely satisfactory, *e.g.*, in the Panama chapters he quotes figures to show that there were eighty-three cases of hæmoglobinuric fever among Barbados natives, while there was only one among natives of Costa Rica; but as no data are supplied as to the relative number of these two classes of labourers, one can draw no valid conclusion. On page 249 the admission rate in 1906 for malaria among a labour force of 26,705 was 821; in 1913 the rate for a force of 56,654 was 76. Now in order that these figures should be comparable it should have been shown that the percentage composition of the force as regards races was the same in 1913 as it was in 1906, but this is not done. One has little doubt that there has been this fall, but the figures *per se* do not completely prove it; if, for instance, the white population had been partly replaced by the relatively immune negro in the interval, this would vitiate the figures.

A very interesting phenomenon recorded by the author is the "flights of mosquitoes" noted in the Canal zone.

These began about 6 p.m. and ceased before 9 p.m. "Hundreds of Anopheles could be seen passing by," and the flights attracted insectivorous birds to activity. The range of flight was about 6000 feet, originating in a marsh and terminating in an inhabited area, the object of the flight being apparently blood.

A most important fact that the author draws especial attention to is that in certain estates in British Guiana malaria has disappeared. Agriculture has in some way, for all practical purposes, abolished it. Anopheles do not breed in the water in land which is cultivated in British Guiana, but Culex do so in abundance. Now a knowledge of what exactly is implied in the term "agriculture" here is of the first importance. We should imagine no more valuable data could be given than would be in an account of the difference between a malarial area and a non-malarial area in British Guiana. This book should be read by all officials who obstruct, or turn a deaf ear to, the claims of sanitation, though there are other necessities of life, as the author points out in his epilogue.

J. W. W. S.

Land raised by "hydraulic filling" on the east bank of the French canal at Gatun. The remains of the swamp trees are still to be seen. From "Rural Sanitation in the Tropics."

THE POLLINATION OF FRUIT TREES.

INVESTIGATIONS carried out in this country, in America, and elsewhere have demonstrated the fact that many of our cultivated varieties of apple, pear, plum, &c., are self-sterile. They have shown, moreover, that whereas a variety

may be sterile when pollinated with its own pollen, it yields an abundant crop if pollinated with the pollen of certain other varieties. Hence it is of considerable economic importance to discover which varieties serve best for mutual cross-pollination.

Mr. Cecil H. Hooper has been engaged in the study of this subject for some years, and he published a short time ago a summary of the results of observations made by others and himself on the pollination of apples, pears, plums, and cherries.

The list of self-sterile apples is surprisingly large. It includes Lane's Prince Albert, Bismarck, Annie Elizabeth, Warner's King, Gladstone, Lady Sudeley, James Grieve, and Cox's Orange Pippin (rarely self-fertile).

It is to be observed, however, that, as indicated in the case of Cox's Orange Pippin, self-sterility is by no means absolute in all these varieties. This, although of no particular importance practically—for a poor setter no less than a completely self-sterile variety requires to be planted with a variety the pollen of which causes it to set fruit freely—is nevertheless significant from a scientific point of view. It means probably that some link in the chain of chemical changes pre-requisite for the germination of the pollen tube on the stigma and its growth in the style is missing, rather than an inability of the sexual nuclei to unite with one another. Thus it is known that the absence of a particular kind of sugar on the stigmatic surface may suffice for the suppression of the germination of a pollen tube. Hence it is most desirable that this problem of sterility of fruit trees should be studied more minutely than has been the case up to the present. The pioneer field work has been done fairly thoroughly; it is now time for the physiological botanist to intervene. He, unfortunately, is so sequestered in his laboratory that he rarely discovers even the existence of the stimulating problems which modern horticulture offers for elucidation.

The establishment of horticultural research stations at Merton, Wisby, and Long Ashton gives ground, however, for the hope that this attitude of aloofness is a thing of the past, and indeed it is these stations that are contributing most to our knowledge of the phenomena of self-sterility of fruit trees.

That the reproductive organs of fruit trees, like those of many other cultivated plants, are subject to grave disturbances is indicated by the fact that not a few apples are very shy of pollen bearing. Among varieties which exhibit this habit, Mr. Hooper mentions Newtown Wonder, King of the Pippins, Irish Peach, Baumann's Red Winter Reinette, Cox's Pomona and Broad-eyed Pippin.

Pears are apt even more than apples to be self-sterile, and such varieties as William's Bon Chrétien, Pitmaston Duchess, Doyenné du Comice, and others require to be planted in propinquity with good "pollenisers." Progressive fruit-growers are, of course, well aware of the stubborn fact of partial or complete self-sterility, and see to it that their orchards contain varieties which supplement each other's pollen requirements; but it is to be feared that many small growers are not so alive to these facts as they should be. However, so long as many of the small orchards of this country are so ill-cultivated as they are at present, self-sterility of varieties is of no great moment to the trees or owners, for the crops would inevitably be poor, in spite of the introduction of good pollenisers.

Of the insects visiting fruit trees and presumably engaged in transferring pollen to the stigmas of the flowers, Mr. Hooper gives an interesting list. In the case of apples observed during 1912 and 1913, the record was:—Hive bees, 72; bumble bees, 26; other wild bees, 2; other insects, 20. The insect visitors to the cherry were in somewhat similar proportions, but in the case of the plum the visits of bumble bees were to those of hive bees as 41 is to 29. How far the reduction in numbers of hive bees due to recent epidemics is likely to have an effect on the yield of apples is an open question.

Frederick Keeble.

[1] "Notes on the Pollination of Orchards." By Cecil H. Hooper. *The Fruit, Flower and Vegetable Trades' Journal*, September, 1915.

PROF. OCTAVE LIGNIER.

Palæobotany recently suffered a serious loss in the death of Graf zu Solms-Laubach and Prof. Zeiller. Another gap has been made in the ranks of the small body of botanists whose work is mainly concerned with extinct plants by the death, on March 19, of Prof. Octave Lignier, who occupied the chair of botany at Caen since its foundation in 1889. Prof. Lignier was born on February 25, 1855, at Pougy (Aube, Champagne). His earlier botanical studies were chiefly concerned with investigations undertaken to test the value of anatomical characters as a guide to the affinities of the Calycanthaceæ and other Dicotyledons. These researches led him to adopt certain views with regard to the important part played by the foliar vascular system (the "meriphyte") in the evolution of the conducting system of the stem. For his original ideas on this subject Lignier did not always receive his full share of credit. He also wrote on the anatomy and floral morphology of many other recent genera; but it is for his numerous additions to our knowledge of Mesozoic and Palæozoic plants that he is best known.[1] One of his most important contributions is the masterly account of *Bennettites Morierei*, a Cycadean "flower," probably from the Gault.

Among other important contributions by Lignier reference may be made to his detailed description of several species of Jurassic and Cretaceous Coniferous and Cycadean stems and some Upper Cretaceous Angiospermous wood referred to the Hamamelidaceæ; his ingenious suggestions with regard to the relationships of

[1] For a list of Lignier's papers, see "Titres et Travaux scientifiques de M. Octave Lignier." Laval, 1914.

the Equisetales and Sphenophyllales; papers on Jurassic floras of France; and especially his recent work, in part in collaboration with M. Tison, on the flowers of the Gnetales and the systematic position of the group. Lignier's activities ranged over a wide field; he was a botanist of marked originality, a generous friend, and a man imbued with the true scientific spirit. It was through his persistence that a botanical laboratory was built at Caen, and under his able direction the University became an important centre of botanical research. A. C. S.

NOTES.

At the ordinary scientific meeting of the Chemical Society, held at Burlington House on Thursday, April 6, Dr. Alexander Scott, president, announced that the council had decided that an extraordinary general meeting of the society should be summoned for Thursday, May 11, to consider the question of the removal of the names of the nine alien enemies from the list of honorary and foreign members of the society.

Replying to a question relating to the inventions branch of the Ministry of Munitions, Dr. Addison said, in the House of Commons on April 10:—The Director-General of Munitions Design is General Du Cane. His salary is 2000*l.* per annum. The Superintendent of Research is Colonel R. A. Craig. His salary is 850*l.* per annum. The present salaries of his staff range from 750*l.* per annum to 240*l.* per annum. It is not desirable to give their names. In addition to the staff of the Superintendent of Research, a number of most eminent chemists and other men of science in the country have for many months given their services to the Ministry of Munitions without payment, and have rendered invaluable assistance to the country.

Sir Colin Campbell Scott-Moncrieff, whose death occurred on April 6, in his eightieth year, was a man of distinguished parts, who achieved reputation in three several directions, as a soldier, as an engineer, and as an administrator. Born in 1836, his military career commenced at the age of twenty, when he entered the Bengal Engineers as a second lieutenant. He was engaged in the suppression of the Indian Mutiny, for which he received the medal. In 1883 he retired with the rank of Colonel. From that date he devoted himself to the inauguration and execution of engineering projects of a utilitarian character, connected in the first instance with the agricultural development of the North-West Provinces, by artificial irrigation. He also held office as chief engineer for Burma. In 1883 his services were transferred to Egypt, where he acted as Under-Secretary of State Public Works at Cairo. There, where perhaps his best and most notable work was performed, his efforts were concentrated upon the more effective regulation of the existing water supply for purposes of irrigation, and during his tenure of office he carried out the restoration of the Great Nile Barrage—a difficult and tedious operation, which extended over a period of six years. A comprehensive review of his labours and of the difficulties which he encountered and overcame is to be found in a paper entitled "Irrigation in Egypt," which was published in the Professional Papers of the Corps of Royal Engineers in 1893. This paper is the substance of three lectures delivered by Col. Scott-Moncrieff before the Royal Engineers' Institute, and it contains much interesting information on the Nile and its treatment, particularly as regards the restoration and adaptation of the barrage, which was effected in circumstances of great discouragement and no little opposition. In 1892 he left Egypt for home, and for the next decade he was in office as Under-Secretary for Scotland. Then, at the beginning of the century, he returned to India to take up duty as president of the Indian Irrigation Commission, for which service he was rewarded, in 1903, with the K.C.S.I. He had previously, in 1887, been made K.C.M.G.

We regret to record the death of Sir Alexander R. Simpson, emeritus professor of midwifery in the University of Edinburgh. Although above eighty years of age, he was active both in mind and body, and it was on his way home from a meeting through the darkened streets that he was knocked down by a motor-car and received injuries from which he died shortly afterwards—on the night of Thursday, April 6. Born at Bathgate, West Lothian, in 1835, and receiving his early education at the local academy, Simpson went to the University of Edinburgh, and began the study of medicine in the apprenticeship days. He was apprenticed to John Goodsir, the anatomist, and amongst his other teachers was Syme. After his graduation he studied abroad at Montpelier and Berlin, acquiring, in addition to a widened knowledge of his profession, that facility in speaking French and German which made him such an admirable and acceptable representative of his University at many foreign congresses. On his return he for some years assisted his uncle, Sir J. Y. Simpson, then at the zenith of his fame, and after an interval of five years spent in practice in Glasgow, succeeded him in the chair of midwifery and the diseases of women and children in the University of Edinburgh. This chair he held for thirty-five years, 1870–1905. In 1906 he received the honour of knighthood. Simpson had a wide knowledge alike of the history, theory, and practice of his profession. He practically grew up with the modern science of gynæcology, and he was always awake to every new development of it, and familiar with everything of importance written upon it in all languages. His contributions to the literature of his department were numerous and valuable: many of them are collected in his "Contributions to Obstetrics and Gynecology." Sir Alex. Simpson took a wide and responsible view of his professorial functions, and interested himself in all that concerned the welfare of his students and the University. Lady Simpson predeceased him several years ago, and he is survived by four sons and a daughter.

The death is announced, at sixty-five years of age, of Sir Stafford Howard, K.C.B., formerly Commissioner of Woods and Forests, a post to which he was appointed in 1893, and retained until 1912. He was also an active member of the Afforestation Committee.

The *Nieuwe Courant* announces the death at the age of fifty-four, of Dr. H. P. Wijsman, formerly professor of pharmacy in the University of Leyden, and since 1908 extraordinary professor of the chemistry of foods and drugs at Utrecht. He was also secretary of the Colonial Institute of Amsterdam.

Science announces that the Avogadro medal has been awarded to Prof. H. N. Morse, of the Johns Hopkins University, for the most important contribution to molecular physics made since the meeting held in Turin in 1911, to celebrate the centennial of the announcement of the hypothesis of Avogadro.

Dr. David Hooper, formerly curator of the Economic and Art Sections of the Indian Museum at Calcutta, has been elected president of the British

Pharmaceutical Conference for the remainder of the current session, in succession to Major Peck, who has been compelled to resign in consequence of the increasing pressure of his military duties.

A series of popular lectures on "Our Tropical Industries," describing the production of rubber, tea, coffee, cocoa, sugar, etc., in the tropical colonies, and illustrated by the collections of the Imperial Institute, to be delivered by Miss Edith A. Browne, on Wednesdays in April, May and June, at the Imperial Institute, at three o'clock, commenced yesterday, April 12. Admission to the series of lectures will be free by ticket, for which application should be made to the director of the Imperial Institute, South Kensington.

The sixty-ninth annual meeting of the Palæontographical Society was held on March 31, Dr. Henry Woodward, president, in the chair. The council's report referred to the temporary diminution of the annual volume of monographs in existing circumstances, but noted that palæontological work was still being actively carried on, and would shortly be offered to the society to the normal extent. Dr. Henry Woodward was re-elected president; Dr. G. J. Hinde was elected a new vice-president; Mr. R. S. Herries was re-elected treasurer; Dr. A. Smith Woodward was re-elected secretary; and Miss Mary S. Johnston, Mr. H. L. Hawkins, and Mr. G. W. Young were elected members of council.

We regret to record the death of Mr. Henry Morgan, on April 3. A brief account of his career appears in *Engineering* for April 7. Mr. Morgan was born in 1834, and was trained in Sheerness Dockyard. After occupying responsible posts in the Royal Dockyards, he proceeded to the Admiralty in 1869, under Sir (then Mr.) Edward J. Reed. Mr. Morgan also served as chief constructor under Sir Nathaniel Barnaby and Sir William White. He retired in 1889, after twenty-five years' active service in the design of warships. He devoted much of his ability to the Institution of Naval Architects, and was a member of council from 1871.

Discussing the question of centralisation in military aeronautics, *Engineering* for April 7 considers that the true function of a central board would seem to be the collection and collation of facts, their transmission to those interested, and the preparation of general specifications, which, so far as practicable, should specify ends, rather than means. Any attempt to centralise design and experiment, and to discourage independent work, will necessarily imply restrictions on the initiation of many able men. A central board, operating with salaried officials, may, no doubt, conduct routine researches accurately and ably; but, in the opinion of our contemporary, a central organisation must not be looked to for important new departures in either science or industry.

According to the *Nieuwe Courant*, the Royal Academy of Sciences of Amsterdam has awarded the following grants from the Van't Hoff Research Fund: 640 francs to Prof. F. Ephraim, of Berne, for the continuation of his studies on the nature of subsidiary valencies; 600 guilders (£50) to Dr. P. E. Verkade, of Delft, for the purchase of apparatus for the determination of heats of combustion; 100 guilders to Dr. D. H. Wester, of The Hague, for a chemical examination of certain species of Loranthus; 200 guilders to Dr. C. H. Sluiter, of Vught, for the purchase of Beilstein's handbook and of materials for an investigation of formaldoxime; 400 marks to Prof. E. Jänecke, of Hannover, for the continuation of his work on melting and transition points under high pressures.

In the *Times* of April 4 Prof. W. C. McC. Lewis points out that the neglect of the science of chemistry in this country is due, not only to the public ignorance of the close connection existing between industry and the most abstruse forms of chemical research, but also to the miserably inadequate salaries paid to chemical assistants in university laboratories. In illustration of the former, he cites, amongst other cases, the work of the Corrosion Committee of the Institute of Metals, at Liverpool University, and the new process recently adopted by the War Office for the production of phenol. In mitigation of the latter, a plea is put forward for the establishment of a chemistry committee of the advisory committee on university grants, with an endowment of 30,000*l.* a year. Compared with the scheme proposed by Mr. C. A. Jacobson for the United States, and noticed in last week's Nature (p. 130), for the creation of a chemical research institute at a cost of one million pounds annually, this is modesty indeed.

The article on Zeppelins by M. Georges Prade, in the *Times* of March 25, has been followed by another on "The Newest Aeroplanes,' by the same author, in the issue of April 7. There being no outstanding aeroplane in the sense that the Zeppelin is an outstanding airship, the treatment is totally different, and becomes a general review of the functions and general characteristics of aeroplanes. It is said that the idea of building one aeroplane which shall combine in itself all the good qualities has proved to be Utopian, and attention is now directed to four types:—(1) Scouting aeroplanes; (2) artillery observation aeroplanes; (3) bomb-droppers; and (4) battle planes. Discussing the question of size, Mr. Prade says that "an aeroplane is too small when it does not even permit a machine-gun to be carried; an aeroplane becomes too large when its increase in power and surface is not accompanied by a proportionate increase in weight-lift capacity." This statement does not carry very far, and limits aeroplanes to quite moderate sizes. Amongst the classes mentioned above, it appears that the lightest is that of battle planes, and the largest the bomb-dropper, the former having a total weight of less than a ton, and the latter an unspecified but not large weight if the horse-power of 200 may be taken as a criterion.

In the last issue of the Journal of the Franklin Institute Dr. A. E. Kennelly suggests a scheme for the co-ordination of the work of American laboratories of applied science. There are now a considerable number of these laboratories, but in some cases the results of investigations are not published, and in others they are not sufficiently widely known. Moreover there is overlapping. "Each laboratory, as a rule, works for and in itself, as though it were the only one in the country. It is almost self-evident that the collective output would be improved, and the cause of engineering advanced, if these various laboratories could be co-ordinated, without imposing on them either hindering restrictions or burdensome expense." Dr. Kennelly therefore suggests that the Franklin Institute should take the initiative, in: (1) Giving publication, so far as it can, to the results reached in these laboratories. (2) Suggesting subjects for research to such laboratories as seem best suited for them. (3) Inviting subjects from the industries and grants for the expenses of research. (4) Encouraging mutual understanding between the laboratories. This matter also deserves consideration in the British Isles. Attempts are being made to promote unity of effort

on the part of the chief scientific and technical societies, and the time seems ripe for a similar movement towards co-operation between the research staffs of the chief colleges and technical institutions.

Miss Margaret Murray contributes a very interesting paper to vol. xlv. of the Journal of the Royal Anthropological Institute, under the title of "Royal Marriages and Matrilineal Descent." She begins by quoting the well-known case of matrilineal descent in the kingdom of Travancore, and then proceeds to show that the same law prevailed under the Old and New Egyptian kingdoms, in the Ptolemaic period, and among the Hebrews in the time of David and of Solomon, the latter being reported by tradition to have gained possession of the kingdom of Sheba by marrying its Queen. She reaches more unfamiliar ground when she seeks to apply the same principle to the succession of the Roman Emperors. Not that indications of the same rule are wanting. Thus it is significant that Julius Cæsar, free to adopt whom he pleased, should have followed the same law of matrilineal descent by adopting Augustus, while something of the same kind may be gathered from the marriages of Octavia and Julia. So Caligula, son of Agrippina, succeeds Tiberius, who naturally wished his own son to succeed him, and there is some reason to believe that the circumstances surrounding the death of Messalina are only explicable by the custom of female inheritance and succession by right of marriage with the heiress. All this is very cleverly worked out, but the facts are not quite conclusive, and a further examination of the royal genealogies, so far as they can now be recovered, is needed before the theory can be fully established.

The *Psychological Bulletin* (vol. xiii., No. 2) reports the papers given at the meeting of the American Psychological Association. The range of subjects treated is very wide, and the detailed investigations are of considerable interest. M. F. Meyer describes a rare case of colour-blindness. It is customary to recognise two groups of two antagonistic colours each, red-green and blue-yellow, and writers on the subject give details of the corresponding forms of colour-blindness, in addition to total colour-blindness. The author of the article before us describes a case of a somewhat unique kind, the subject regarding blue and green as one colour, and red and yellow as another. For him the division point in the spectrum occurs in the yellowish-green region: on one side everything is one colour, which he calls indiscriminately either green or blue; on the other side everything is another colour, which he calls indifferently red or yellow. He has no need for the four names. The author suggests that at a time when only two chromas existed, Nature vacillated between one type of animals having the dividing point in the spectrum in the (normally) bluish-green region, and a second type having the dividing point in the yellowish-green region; ordinarily the former type has prevailed, but there is still a trace of the latter.

We have just received the report on Cetacea stranded on the British coasts during 1915. This is the third of its kind issued by the trustees of the British Museum, and prepared by Dr. S. F. Harmer, F.R.S., the keeper of the Zoological Department. Each of these reports not only adds to the value of its predecessor, but also emphasises the importance of this attempt to determine the precise character of the Cetacean fauna of our seas, and its seasonal migrations. Already it is clear that species hitherto supposed to be but rare and accidental visitors may prove to be, at any rate, annual visitors to our shores. This seems to be true, for example, of Cuvier's whale (*Ziphius cavirostris*), which, as Dr. Harmer has demonstrated, may easily be confused with the bottle-nosed whale (Hyperoodon), at any rate in the case of immature specimens. One of the two specimens recently acquired by the museum was at any rate thus mistaken. From the evidence in this report it would seem that Mesoplodon is represented in our seas by two, and perhaps three, species. Thus from a faunistic, as well as from an economic, point of view it is plain that the task which Dr. Harmer has set himself is one of extreme importance.

The Journal of the East Africa and Uganda Natural History Society (vol. v., No. 9) contains a paper by Mr. C. W. Hobley on the alleged desiccation of East Africa, which will be read with interest by anthropologists, as well as by those for whom it is more especially written. The author remarks that between Kismayu and Port Durnford there are said to be sixty miles of coast full of ruins, and, again, north of Port Durnford, there are innumerable ruins of stone buildings. No record remains of the builders, but they are commonly supposed to have been early Persian settlers. But the settlements seem to have been formed since the establishment of the Mahommedan religion, for there are numerous remains of well-built stone mosques, and myriads of stone graves of the Moslem type. The author is inclined to believe that they may date back to as far as Himyaritic times. In the Somali hinterland, in Juba-land, there are large numbers of artificial mounds, many as much as 30 ft. high, which are believed to be the funeral mounds of an extinct race. At the earliest opportunity these mounds should be explored.

The Journal of the Franklin Institute for February contains a useful survey of what is known in regard to the production of light by animals. This survey, which began with the January issue, and is not yet completed, is devoted to the coelenterates. Herein the phosphorescent discharge takes the form of granules mixed with mucin secreted by special cells of the epithelium. The discharged matter—luciferine—becomes luminous on coming into contact with the free oxygen contained in the sea-water. The author, Prof. U. Dahlgren, of Princeton University, cites a number of experiments made to determine the nature of the stimuli which produce luminescence, and these all show that light production is at its best at the optimum temperature at which the animals usually live. The eggs of ctenophores have often been said to emit light, but the author is unable to confirm this statement. The early segmentation stages, however, develop luminosity, and this increases in intensity from the gastrula stage onwards. Among the echinoderma, which, with the Mollusca, are reviewed in the March issue, luminescence has been demonstrated only in the "brittle-stars," or Ophiurids. It is exceedingly rare among the Mollusca. The author discusses at some length the well-known case of the pelagic Phyllirrhöe, and the remarkable instance of *Pholas dactylus*, which, though always buried, yet has large areas of the body provided with luminous glands. The light from these shines brightly when the animal is removed from its shell, but during life is manifested only by means of a mucous slime, discharged from the exhalant siphon, which alone is exposed to the outer world.

An extensive ecological study of the fauna of prairie and forest regions near Charleston, Illinois, has

lately been published (Bull. Ill. State Lab. Nat. Hist., vol. xi., 2, 3), Dr. C. C. Adams describing the invertebrates and Mr. T. L. Hankinson the vertebrates. The regions dealt with seem to represent a remnant of the wild country of the State, now as a whole highly cultivated, and altered by human agency. The animals are divided into prairie and woodland dwellers, each with several groups of "associations," and the extensive series of photographs enables the reader to realise the nature of the localities described. Doubtless the invertebrates listed represent only a fraction of the fauna of the districts, but the authors may be congratulated on having collected so large an array of facts while wild areas are still at their disposal for study.

The gram crop in India (*Cicer arietinum*) has occupied the attention of Mr. and Mrs. Howard and Mr. A. R. Khan at Pusa, and their results, which are of considerable scientific and economic value, are published in Memoirs of the Department of Agriculture in India, vol. vii., No. 6, for December, 1915. Gram is an important cold season food-grain in India, and some 18,000,000 acres are devoted to its cultivation every year. The best returns are obtained on light, high-lying, well-drained land, and in a wet season or on heavy land the yield is very considerably lessened. Another important factor is the time of sowing. Figures are given showing the root formation in relation to soil moisture, and the seed yield is found to be directly correlated with the root system, for when this is stunted, owing to too moist conditions, no seed is produced. Twenty-five types of gram have been bred at Pusa, and a careful classification of them is given in the paper. It is found that different types are suitable for different localities. The power to set seed, habit of growth, time of flowering, are all important features. The best type is a white gram, which in addition to this colour quality has given a yield of more than 20 maunds per acre.

In no part of the world, not even in Japan, are the observations of earthquakes published on so lavish a scale as in Italy. As an instance of this, we have lately received the notices of earthquakes observed in that country during the year 1910. They form a volume of more than six hundred pages, which is issued as a supplement to the Bollettino for 1913 of the Italian Seismological Society. In it, Dr. G. Marinelli has collected the recorded observations of all local earthquakes, as well as those of external earthquakes which are registered instrumentally in Italy. Useful additions to the catalogue are lists of thirty-two Italian observatories with the constants of the different instruments which they contain, and of the epicentral regions of the stronger earthquakes. If we might offer two suggestions, it seems to us that the separation of the two classes of local and external earthquakes, and brief discussions of the materials collected for the more important local earthquakes, with maps, would add very greatly to the value of the catalogue.

At the last meeting of the Illuminating Engineering Society the desirability of standardising the materials used in lighting glassware, and the sizes of chimneys, globes, reflectors, etc., was discussed. Letters from manufacturers were read pointing out that the multiplicity of shapes and sizes of glass was found to be a great drawback. A special problem is the production of "heat-resisting" glassware for globes used with high-pressure gas lamps, and other high-temperature illuminants. Other speakers remarked on the variations in quality met with in opal glass as regards absorption, uniformity of diffusion, and colour. Two special varieties of glass which particularly require standardisation are those used respectively for producing "artificial daylight" from various illuminants, and for neutral absorbing screens in photometry. Neutral-tinted glasses of guaranteed absorption cannot readily be obtained in this country, although they play an important part in many photometric and optical instruments. Several members of the Glass Research Committee of the Institute of Chemistry were present, and gave some particulars of the work of the Committee on laboratory and chemical glasses. In the course of the discussion it was suggested that the Illuminating Engineering Society should appoint a Committee on Lighting Glassware.

The Netherlands Meteorological Institute has recently published the fourth and last part of the new edition of the oceanographical and meteorological observations in the Indian Ocean; the part comprises the months of March, April, and May from the observations for the years 1856–1912. Many of the observations are obtained from our English Meteorological Office and from other European weather offices. The results are published in a tabular form, in very great detail, and are grouped together in order of 10° ocean squares, and are subdivided into single-degree squares. Results are given for ocean currents, winds, barometer, air and sea temperatures, cloud, mist, rain, and hail. Charts are published in a separate volume, giving in a graphical form the general circulation of winds and currents, and the isobars, and isotherms, of air and sea, together with the general trade routes. The number of observations available for each element is given, so that the value of the results can be estimated, and for several of the elements more than a million observations have been used for the year. This work of the Dutch Meteorological Institute formed the subject for discussion on Monday, March 13, at the Meteorological Office, at South Kensington, the discussion being opened by Admiral Farquhar.

"The Spread of Tuberculosis," by Dr. L. Cobbett, is in the press for publication in the "Cambridge Public Health" series (*Cambridge University Press*). The following works are in preparation for inclusion in the same series:—"Ticks as Carriers of Disease," Prof. G. H. F. Nuttall; "Serum Diagnoses," Dr. C. Browning; "The Purification of Water in Sedimentation, Filtration, and Precipitation," Dr. A. C. Houston; "The Purification of Water by Ozone and Chlorine; and Domestic Filters," Prof. G. Sims Woodhead; "The Principles and Practice of the Dilution Method of Sewage Disposal," Dr. W. E. Adeney; "Disinfection," Dr. C. W. Ponder; "Housing in Relation to Public Health," Dr. C. J. Coleman; "School Hygiene," Dr. E. T. Roberts; "Soils, Subsoils, and Climate in Relation to Health," G. Walker; "Meat Inspection," Dr. W. J. Howarth and T. D. Young; "Vital Statistics," R. Dudfield and G. U. Yule; and "Foods, Sound and Unsound," Dr. H. C. Haslam. For the "Cambridge Farm Institute" series the following are in preparation:—"Plant Life in Farm and Garden," Prof. R. H. Biffen; "The Feeding of Farm Animals," Prof. T. B. Wood, and "Common Fungus and Insect Foes," F. R. Petherbridge, and for the series of "Cambridge Agricultural Monographs":—"Poisonous Plants," H. C. Long: "The Strength of Wheat Flour," Prof. T. B. Wood; "The Constitution of the Soil," Dr. E. J. Russell; and "Disease Resistance," Prof. R. H. Biffen.

OUR ASTRONOMICAL COLUMN.

COMET 1916*a* (NEUJMIN).—Prof. E. Strömgren, in a post-card dated April 1, from the Copenhagen Observatory, gives the following observation of Neujmin's comet at Bamberg on March 23:—10h. 7m. 15s. M.T. Bamberg; α app. = 9h. 15m. 7·15s.; δ app. = +2° 18′ 31·9″. The corrections to the positions given in M. J. Fischer-Petersen's ephemeris are, for March 23: +7s., +1·0′.—Copenhagen Post-card No. 16 gives the following continuation of the ephemeris:—

12*h*. *G.M.T.*

1916		R. A. h. m. s.		Dec. ° ′
April 20	...	10 2 41	...	− 7 34·0
22	...	6 47	...	8 6·5
24	...	10 56	...	8 38·0
26	...	15 9	...	9 8·6
28	...	19 25	...	9 38·3
30	...	23 44	...	10 7·1
May 2	...	28 5	...	10 35·1
4	...	32 28	...	11 2·2
6	...	36 53	...	11 28·6
8	...	41 20	...	11 54·3
10	...	10 45 50	...	− 12 19·3

OCCULTATION OF MARS, OCTOBER 2, 1915.—Observations were made by W. Voss at Altona (*Astronomische Nachrichten*, No. 4831). Although the altitude was low (17°) and the air unsteady, all four contacts were recorded. The successive phases anticipated the calculated times by 10·0, 13·8, 27·1, and 31·8 seconds respectively. Corrections to the ephemeris of the moon have been calculated from the observations of second and third contacts. Taking into account the effect of the phase of the planet on the emersion, it appears that the moon is 10″ further on its path, and in the direction at right angles 3″ to the north of the position given by the Nautical Almanac.

THE RADIATION LAWS AND STELLAR PHOTOMETRY.—In *Meddelande* No. 67, Lund's Observatory, Dr. C. V. L. Charlier continues a statistical investigation of the consequences of various laws of radiation in regard to stellar light emission. Although Planck's law does not, yet both Stephan's and Wien's radiation laws indicate the existence of an inversion-temperature (visual >18,000°), at which for a given wave-length the radiation is a maximum recalling the results obtained by Kovesligethy. This important inference applied to the phenomena of new stars is considered to remove the objection to collision hypotheses, justifying the ingenious suggestion that the observed rapid diminution in brightness is due to the fact that the inversion-temperature has been passed. The investigation has a direct bearing on the question of colour-indices. A rigorous interpretation of the usual determinations is shown to require the numerical evaluation of several instrumental factors, which determine the difference between the measured and the actual energy.

DARK MARKINGS IN THE SKY.—Some striking photographs possibly showing dark objects are reproduced in a paper by Prof. E. E. Barnard in the January number of the *Astrophysical Journal* (in modified covers). A dark marking in Cepheus (1860·0, R.A. 20h. 48·0m. +59° 6′) would almost pass for a negative of the gaseous nebula N.G.C. 6995. Prof. Barnard advances the interesting suggestion that these dark bodies are rendered apparent by a faint general luminescence of the background. This bears a sort of reciprocal relation to Prof. H. H. Turner's suggested widespread absorbing areas, yet it is not impossible that both refer to coincident areas in space.

A CLUSTER OF NEBULÆ IN CETUS.—To the north of the 9·5 mag. star, B.D., 2° 128′, Prof. M. Wolf has found a rich cluster of small nebulous objects. In a region 30′ diameter around R.A. = 0h. 49·0m., $\delta = -20'$ (1855), no fewer than fifty nuclei were discerned with the 16 in. The nebulæ are nearly as abundant but much smaller than in the nebulous areas in Coma Berenices and Virgo, and all are to be regarded as either the remnants of, or the brightest parts of, very faint spiral nebulæ. Replicas on the tiniest scale of the Andromedæ nebulæ are very numerous. The cluster is not strongly condensed, but it is rather the arrangement in winding lines that attracts attention (*Astronomische Nachrichten*, No. 4833).

THE NEW CHEMICAL LABORATORIES AT UNIVERSITY COLLEGE, LONDON.

THE provision of properly equipped chemical laboratories with ample facilities, not only for teaching, but also research, is a matter of the utmost national importance. Fortunately, University College, London, has been engaged for the last five years in the endeavour to obtain a chemical laboratory worthy of its famous tradition, associated with the names of Graham, Williamson, and Ramsay, and equal to the strenuous demands of the present day and the years of keen scientific and industrial rivalry which await all civilised nations after the war.

As a result of strenuous effort and the generosity of many private benefactors and public bodies, a fine new building has been erected. The main façade has a frontage of more than a hundred yards, whilst the building itself occupies an area of about 18,000 square feet. The basement, which is, in reality, only a half-basement, and is amply illuminated owing to the use of prismatic glass in the windows and of white tiles and white glazed bricks on the walls, is devoted mainly to physical chemistry, electrochemistry, and technical chemistry, for all of which spacious laboratories are provided. A novel feature here is the provision of a very large room, about 50 ft. square, for the carrying out of chemical operations on an engineering scale (Fig. 1). This room will be provided with gas, water, steam, compressed air, electrical power, and special ventilation. The ceiling is very high, and strong steel girders run across from wall to wall at approximately half the height from floor to ceiling. These enable scaffolding to be rapidly erected, heavy machinery and apparatus to be moved about, tanks to be hoisted into position, etc. As every practical man knows, "technical" chemistry (a term very much misunderstood in this country) is simply, when effective, a combination of good chemistry, good engineering, and good business. The ample provision made at University College for adequate engineering tests of chemical processes marks the beginning of a new era in the development of university chemical laboratories. It is significant that this provision was designed and planned several years before the outbreak of the present war, and owes its inception to the insight and prescience of Sir William Ramsay. In September, 1915, the laboratory of technical chemistry was placed at the disposal of the Ministry of Munitions, and has been in constant use since then for the working out of the chemical engineering details of a new process, under the supervision of Prof. B. D. Steele, of the University of Queensland. As a result of this work a large new factory is in process of erection by the Government.

The basement also contains a large, well-equipped workshop (the equipment of which was made possible by the generosity of Dr. R. Messel, F.R.S.), and special rooms for storage batteries, electrical machinery, the liquefaction of gases, and spectroscopic and calorimetric work. In the rooms devoted to physical chemistry ample accommodation is provided

for carrying out every class of electrochemical work. Indeed, a marked characteristic of the building is the ample and adequate provision of space for physical chemistry and electrochemistry.

The ground floor contains the large chemical lecture theatre (with seating accommodation for 240 persons), the physical chemistry lecture theatre (100 persons), the library, and the analytical and inorganic laboratories. There is also a room for metallurgical work, and a store-room.

The first floor is devoted entirely to organic chemistry, and contains a spacious main laboratory, organic chemistry lecture theatre (100 persons), organic chemical store, combustion- and furnace-rooms, etc. On this floor is also a room for spectroscopic work.

The second floor contains the "first year" laboratory (with accommodation for 100 students), the department of pathological chemistry, and numerous research rooms. Next to the provision made for instruction in engineering and physical chemistry, perhaps the most marked feature of the building is the accommodation provided for research work. There are no fewer than twenty-seven rooms devoted exclusively to post-graduate and research work, providing ample accommodation for at least sixty research workers. These rooms are suitably distributed throughout the building. In this respect it will compare favourably with the largest and most famous laboratories of the Continent. One may, perhaps, go so far as to state that when the internal equipment is complete the laboratory will surpass any chemical laboratory to be found in Germany.

Unfortunately, the outbreak of war occurred at a time when the internal equipment was incomplete. At present the laboratory is entirely devoid of electrical machinery, storage batteries, electrical power wiring and switchboards, and almost, if not entirely, wanting in instruments and apparatus for physical chemistry and electrochemistry. There is also a great want of many pieces of apparatus required for advanced study and research in inorganic and organic chemistry. A sum of about 20,000*l.* is urgently required in order to complete this internal equipment, without which the laboratory will be unable to fulfil its great purpose of training the research chemists of which we stand at present so badly in need. The country cannot afford to lose a moment. In the immediate future thousands of chemists will be required trained in the methods of research. Every well-equipped chemical laboratory is therefore an asset of the highest national importance. Not only power and wealth, and national well-being, are dependent thereon, but our very existence as an independent and civilised community. For if the events of the last two years have shown that war is dependent on chemical science, it is still more true that without it there can be no prosperity and security in time of peace. The thorough equipment of our chemical laboratories is therefore not only the best possible investment of national funds, but an indispensable condition of national security.

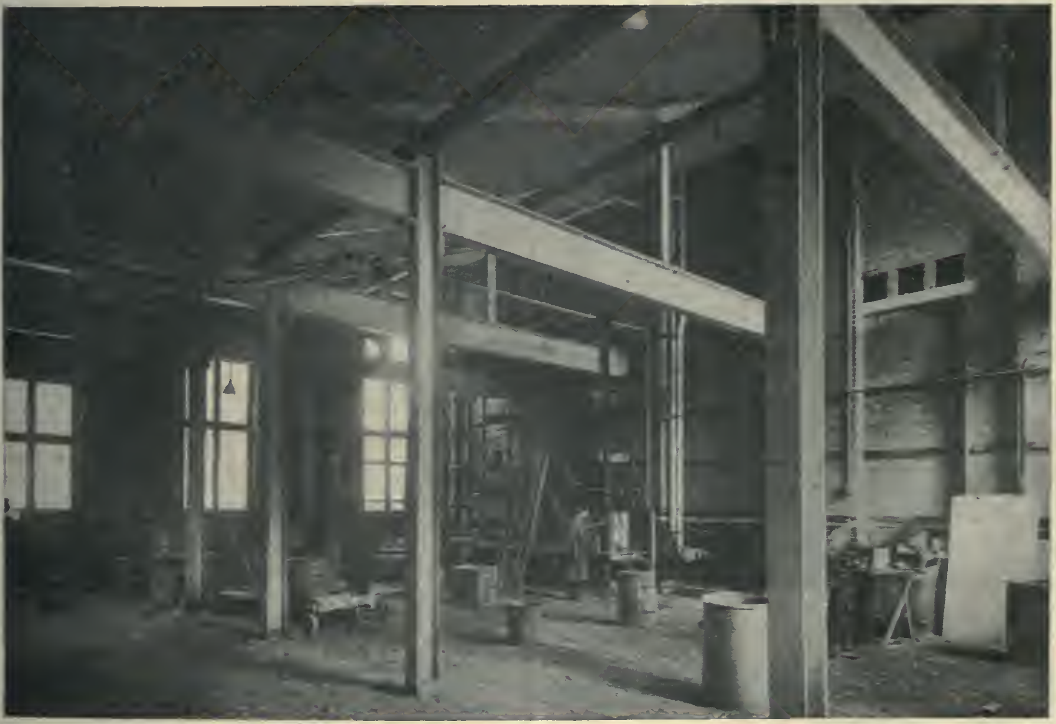

Fig. 1.—Laboratory of Technical Chemistry, University College, London.

We notice with very great pleasure that Sir Ralph Foster, Bart,, has promised 5000*l.* on condition that the remaining 15,000*l.* is obtained within a reasonable period of time. Sir Ralph Foster had already subscribed more than 34,000*l.* to the building fund, so that not only University College, but chemical science in general owe him a deep debt of gratitude. Sir William Ramsay has generously promised 500*l.* for the purchase of books and journals for the library of the new chemical laboratories. It is intended to call the library the "Sir William Ramsay Library," in commemoration of the great work he has done for chemical science. But in order to make the library worthy of its name another 500*l.* will be required for the purchase of books and journals, and about 500*l.* for library fittings.

INSTRUMENTAL HARMONIC SYNTHESIS.

THE Journal of the Franklin Institute for January contains a detailed description by Prof. Dayton C. Miller of a "32-element harmonic synthesizer" (would not synthetiser be more euphonious?), which appears to be admirably designed for many purposes. The main intention is to test the accuracy of any given harmonic analysis by recombining the harmonic terms and comparing the curve so obtained by synthesis with the original form analysed.

The principles of construction of the instrument are the same as those exemplified in Kelvin's tide predicter, but the investigations in photographic records of sounds for which the instrument was devised led to important differences in detail. For example, instead of a metallic ribbon threading the pulleys connected with the elements, a flexible chain of the chronometer fusee type is used. One end of this chain is attached to the pen-carriage above the drawing board on which the record is produced; the other end supports a weight, and the chain is clamped at a convenient intermediate point to a bar which passes under the chain as it crosses and recrosses from pulley to pulley. If the clamp is set at the far end of this rod, all the 32 elements influence the motion of the recording pen. If, however, the higher elements are not to be used, the clamp is shifted nearer to the drawing-board, and the pen is not influenced by the movements of these higher elements. The elements are arranged upon a table with their shafts vertical, and are geared together in such a way that when a handle is turned the rates of rotation of the successive elements are as the numbers 1, 2, 3, 4, etc., up to 32.

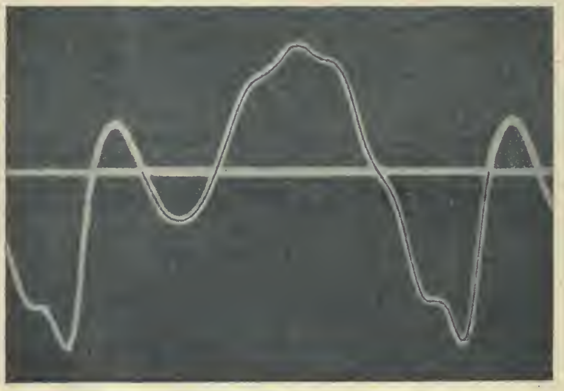

Fig. 1.—Proof of the analysis of a curve by synthesis.

The satisfactory action of the instrument is well shown in a figure in which the synthetic reproduction of the analysis of the curve of an organ-pipe note is superposed upon an enlarged photograph of the original (Fig. 1). There is perfect coincidence. Another figure illustrates the sound wave from a clarinet and gives the harmonic components to the 29th term. Particularly interesting also are the representative curves built up of 15 or 30 terms of certain well-known Fourier series, which when summed to infinity give harmonic forms composed of straight lines. Beautiful examples are also given of beats obtained by the combination of two harmonic forms the frequencies of which are in the ratio of 10 : 29, 15 : 29, and 29 : 30. It should be mentioned that the instrument was originally designed to be used in connection with Henrici's analyser, which requires that all curves for analysis be drawn with a wave-length of 400 millimetres.

CEMENTS AND CLAYS.

THE Bureau of Standards (U.S. Department of Commerce) issues from time to time Technologic Papers bearing on various subjects of practical importance. Several of these papers dealing with cements and related subjects are before us.

No. 47 of the recent pamphlets deals with "The High-Pressure Steam Test of Portland Cements," and it is inferred from the results of the official investigation that the value of this rapid test varies greatly with the conditions (especially when abnormal) under which the material is to be employed. No. 48 describes a new "Air Analyser for Determining the Fineness of Cement." The chief distinguishing feature of this new elutriator is the principle of blowing an unretarded stream of air down into the cement from above, the sample being completely and continuously exposed in a conical bulb to the action of the air. It has been found to be well adapted for separations of various hard-grained materials, and might prove useful in other directions.

No. 51 refers to "The Use of Sodium Salts in the Purification of Clays and in the Casting Process." It is of special interest to those who are engaged in the ceramic industries, and in the working of clay deposits, but, being largely concerned with phenomena depending on viscosity, it may appeal to a wider circle. From results of experiments it is inferred that the German electrical osmosis process plays no important part in the actual purification of clays, but facilitates the deposition of the suspended particles on the electrode. The essential feature of the osmosis process appears to be the preliminary sedimentation process, in which a small proportion of caustic soda or other electrolyte is added to the clay mixed with water, and after well stirring, the coarser material is removed by means of screens and settling. During the investigation a new efflux viscosimeter of simple construction was devised, consisting of a brass tube with appropriate fittings. This inexpensive instrument is stated to be sufficiently accurate for purposes of comparison, the kinetic and temperature corrections applied in precise measurements not being necessary for technical work. Possibly the instrument (or some modification of it) might find useful application in connection with other technical processes where viscosity is an important factor. J. A. A.

PRODUCTIVE RESEARCH IN THE UNITED STATES.[1]

THAT the scientific method, which furnishes the instruments and the criteria for effective investigation, is now gaining esteem with unreflective as well as with reflective minds is in evidence in nearly every field of current activity. In the report for the year 1914 attention was directed to the rise of other research establishments and to the relations of reciprocity the institution should sustain to them. Several of these have effected organisation during the past year, and more such are in process of development.

Simultaneously with the rise of other research organisations, the scientific method is rapidly gaining control in the direction of commercial and industrial enterprises. Indeed, the phrases "scientific management," "industrial efficiency," and the like, are now so much over-applied and so often misapplied as to render them offensive to judicially conservative minds; for herein likewise, as in most other contemporary affairs, there is a popular tendency to anticipate the

[1] Abridged from the Report of the President of the Carnegie Institution of Washington contained in Year Book No. 14, 1915.

marvellous, and hence to obscure the realities of the forward movement now going on. Thus one might infer from current literature that the doctrine of efficiency is altogether new and that it has sprung suddenly from a few Americans and from the general staff of the German army. It is unnecessary to explain that this doctrine is not new, that it has undergone a long course of development, and that it did not originate as commonly supposed. What is new about it is a growing collective consciousness of its validity and a rapidly increasing apprehension of the advantages it may bring in many, if not most, fields of endeavour. But appreciation of this doctrine is neither more nor less than a recognition of the scientific method the beginning of which dates far back, prior to the period of unwritten history of primitive man.

A far-reaching effect of the determinate introduction of the principles of science in commercial and industrial affairs is seen in the resulting diffusion of sound learning among the masses of men. Increase in efficiency in such affairs requires, in general, application of a wide range of demonstrable principles, all of which must stand the tests of economic practicability. The so-called labouring man, therefore, as well as the manager, must become familiar with a correspondingly wide range of facts, methods, and appliances affording typical illustrations of those principles. Thus many manufacturing plants are now great laboratories supplying instruction to operatives, although nominally conducted with quite other objects in view; while some individual machines, like the internal-combustion engine, embody in their construction and operation striking and easily acquired lessons in certain fundamentals of physical science.

But what is more important in this connection is the general recognition of research as an essential preliminary to progress. Accordingly, numerous national organisations are now forming research committees for the investigation of problems common to their several interests, while not a few individual establishments are conducting special research laboratories the contributions of which to knowledge must be justly measured by a much higher standard than that of commercial profit alone. In this process of evolution the conventional divisions of pure and applied science are coming into closer contact and the invidious distinctions between them, often set up disadvantageously to both, seem to be slowly disappearing.

Fundamentally related to the application of the scientific method in increasing measure in nearly all fields of inquiry is the question of the costs involved, although it has been little considered and is often contemptuously disregarded both by enthusiastic investigators and by optimistic financiers. It is, in fact, in its entirety, often a question of great complexity, involving as a rule many difficulties with "personal equations," and all the entanglements due to the uncertainties which successful research seeks to remove. A statement of certain of its more obvious aspects may help to remove common misapprehension. Briefly, these aspects may be stated as follows:—

(1) Sound research, like any trustworthy work, is expensive in proportion to its comprehensiveness and thoroughness.

(2) The number of projects worthy of investigation is now far greater than can be adequately financed, and hence advantageously pursued, either by any single agency or by all such combined; and the prevalent lack of financial support for this kind of work appears destined to continue indefinitely, certainly so long as there is no general recognition of existing conditions or of practicable ways of improving them.

(3) Each research organisation must therefore choose for itself at any epoch the field, or the fields, it will cultivate, and must restrict itself to them. No such privately endowed organisation may seek to delegate its duties to others, to play the *rôle* of paternalism, to undertake the functions of a scientific clearing-house, to secure monopolistic privileges, or to engage in propagandism, without danger of defeating its primary purposes.

That large sums are now spent annually by Governments, by municipalities, and by industrial organisations in defraying the costs of investigations, sums vastly greater in the aggregate than the combined incomes of all existing endowed research organisations, is a fact which needs to be visualised as a preliminary to an understanding of the relatively narrow limitations of the resources and capacities of the institution.

Thus, to illustrate, in the conduct of work which may be fittingly called research, the United States Government spends annually not less than twenty times the income of the institution. It matters not that this work is often designated by the ambiguous word "practical," or by the misleading phrase "applied science." In so far as it deals with facts and principles, and substitutes knowledge for ignorance, it is worthy of prompt recognition and unstinted support.

If, for example, the United States Department of Agriculture can succeed in supplanting "lunar methods" in husbandry by methods founded on physical fact and verifiable induction, it will be entitled to conspicuous distinction in the annals of American science. But while antithetical words and phrases continue to befog contemporary thought it may be easily ascertained, and should be better known, that the United States Government, through its numerous departments and bureaus, is now carrying on, and has in recent decades accomplished, a large amount of high-class research, the annual costs of which quite overshadow the income from any existing research endowment. It may be as easily ascertained, and should be as well known, that no such endowment can be reasonably expected to supplant governmental functions or to supplement governmental resources. The legislator who sees no reason why the institution may not undertake electrification of postal routes, the publicist who entertains fears lest a few endowed organisations should secure a monopoly of research, and the educator who imagines the income of the institution sufficient to meet academic needs and emergencies, are all alike deceived by fallacies which become manifest as soon as one is asked to assume responsibility for their consequences.

In connection with these matters of public concern, it is fitting to remark that while the world at large has entertained all manner of fictitious expectations from the institution, its actual development has proceeded in conformity with the limitations of its income and the conditions of its environment. As a matter of fact, it is now essential to curtail research in order to live within income, since the purchasing capacity of monetary standards, which has fallen by more than 30 per cent. during the last two decades, appears to be still diminishing.

Characteristics of the Carnegie Institution.

It appears advantageous now, in the interests of all concerned, after a decade of patient observation of actual developments and of considerate attention to an unsurpassed wealth of private and public opinion, to state briefly the ideas and the ideals which have animated the present administration and seem fitted to endure in the conduct of any similar organisation.

The institution is an establishment for the conduct and for the promotion of original research, the results of which are given freely to the world.

It is important in this connection to offer an answer to the underlying question perennially put directly, and

indirectly, to the institution, namely, "What is research?" The answer to this question is contained in the answer to the larger question, "What is science?"; for the methods of research are the methods of science. The meaning of this much used and much misused term is now well defined. It was established during the last half of the nineteenth century, although in common parlance it may still mean anything from "skill in boxing" to the prediction of solar and lunar eclipses.

In a summary way science presents itself under three distinct stages, to wit:—(1) The elementary stage of observation and experiment, or the fact-gathering stage; (2) the secondary stage of comparison, measurement, and calculation, or the statistical stage; (3) the stage of correlation under theory with capacity for prediction. But within the limits of these distinct stages there is endless diversity of detail, and hence the widest latitude for amateurism, dilettantism, and even pseudo-science. Thus it happens not infrequently that inquiry is made whether the institution undertakes any other than "scientific investigations," whether its work is limited to science, or whether it seeks to enter the domains of philosophy, metaphysics, etc. Concerning these matters, the attitude of the institution is at once liberal and critical, liberal in recognising all branches of demonstrable knowledge, and critical in respect to all unverified and unverifiable representations. No attempt has been made to limit recognition to the domain of mathematico-physical science or to the quite unhappily designated domain of "natural science."

It would be rash to assert that the methods and the inductions of science, which have cost more than twenty centuries of laborious effort in their evolution, are not still susceptible of many or even endless improvements. But these methods are now so well defined and so well known by all acquainted with the history of human progress that it is no longer essential to use the adjective "scientific" in qualification of the words investigation and research. One may safely assume, for administrative purposes at any rate, that investigations which purport to be unscientific or superscientific do not fall within the scope of a research organisation. And in conformity with this view the term science may be no longer limited advantageously to designation of the mathematico-physical sciences (including the biological and the so-called natural sciences), which for certain obvious reasons have thus far helped most to fix its meaning.

But while the term science should be interpreted in the most comprehensive and liberal manner, experience teaches that its criteria should be strictly observed and impartially applied. Liberality of inclusion and consideration may not be construed as implying leniency of judgment in matters scientific. Science furnishes no royal road to learning. It will undertake to blaze trails, to set up constructions conformable to the laws of the universe, and to test ideas, hypotheses, and theories; but it is unable to work in regions from which its methods and criteria are excluded.

The most striking characteristic of the institution is found in its departments of research. These are absorbing the bulk of the institution's income. They are devoted to fields of inquiry in which continuity of effort over long periods of time is a prime requisite. Their problems, like many of the phenomena under investigation, are of a secular nature and their progress may not be measured adequately in terms of an interval shorter than a decade. They are centres of activity which, if properly sustained, should continue to contribute additions to knowledge the fuller fruition of which can be appreciated only by our successors.

The questions most frequently raised with respect to these departments are:—(1) "What practical results are expected from them?" (2) "Assuming them attainable, will the expected results justify the costs entailed?"; (3) "When will the work of any department be completed?"

(1) An essential preliminary in answering the first question is removal of the obscurity which commonly attaches to the word "practical." Those who use this word freely are rarely competent judges of research or of the accessions to learning secured thereby. What is practical to them is usually confined within the limits of personal experience instead of being permitted to fall within the far wider limits of the experience of our race. He who would venture an off-hand opinion concerning the practical, or directly realisable utilitarian, value of any proposed investigation must needs be uncommonly wise or possess a temerity not derived from an acquaintance with the history of science. This history demonstrates in the clearest manner that every established fact, every newly-discovered principle, and every generalisation from fact and principle are sooner or later turned to advantageous account. Moreover, this induction from history is now so well established that a research organisation as such should never concern itself seriously with the question whether a proposed investigation will turn out to be of immediate utility. The question it should ask is: "Whether it is now practicable to undertake the proposed work and do it thoroughly well?" If this is decided in the affirmative, the organisation may proceed with equanimity, confident of the final, even if doubtful of the contemporary, verdict.

On the other hand, while holding to the views just indicated, it is not necessary to ignore equally important items of mundane wisdom. It needs to be kept in mind that not all worthy subjects of research are at any epoch co-ordinately practicable of pursuit. In fact, there may be enterprises quite unready for investigation by a given organisation at a given time, and other enterprises which under existing conditions would result only in a waste of energy and resources.

(2) In answer to the second question it may be said that while there is inherently an element of uncertainty in respect to the comparability of returns with outlay in the conduct of research, this uncertainty is in general much less than in most unexplored fields for investment of effort and capital. Systematic research is quite certain to secure some advances; even negative results are often of great value; and the elimination of error is almost as important as the discovery of truth. Here, again, appreciation of the time element is essential. A just verdict cannot be rendered by our contemporaries; it must be left to posterity. Progress is not so much for the individual as for the race. It should be observed, also, that the costs of progress attributable to deliberate investigation have been, and are still, vanishingly small in comparison with the costs of the less contemplative forms of human endeavour. But who shall say that the permanent returns from these two contrasted realms of social effort are not more nearly inversely than directly proportional to the respective outlays?

The appalling events now absorbing the world's attention are painfully instructive in seeming to prove that in some of his efforts to understand the cosmos wherein he appears to play a unique *rôle* man has met with little or no success during the past twenty centuries; on the other hand, during the same interval, his efforts along scientific lines to interpret that cosmos have been rewarded by extraordinary advances, the aggregate of which constitutes the bulk of the learning we may pass on unreservedly to our successors. The superiority of the learning of to-day over that of the first centuries of our era is indicated, for example, in the difference be-

tween the navigation of the Greeks and Romans by aid of knowledge and appliances available to them and modern navigation by aid of the compass, the sextant, and the nautical almanac.

(3) When the institution was organised there was a widely spread opinion that much of its work would prove to be transitory, requiring here and there temporary subsidies to complete investigations already started and to publish conclusions already formulated. It was also commonly held that the institution could act as a sort of promoter, starting by aid of initial grants many worthy undertakings and leaving them for subsequent support to the grantees themselves or to the establishments with which the grantees were connected.

Closely related to these opinions was another to the effect that a large amount of valuable work could be accomplished under academic guidance by needy students who might thus earn from the institution small stipends while doing the drudgery and acquiring the inspiration of research. But these plausible theories, praiseworthy enough in the abstract, failed to meet the requirements of conditions as they actually developed. It soon appeared that the completed investigations, or those nearly ready for publication, were not numerous. It was found that stimulating promising enterprises in other establishments by means of initial grants called, in general, for sustaining subsidies; and that in some instances such subsidies from the institution had the sinister effect of decreasing independent support for research. And as for the students from whom so much for so little was expected, it turned out that they were preoccupied as a rule with the elementary notion that research means that modicum of investigation which leads to higher academic degrees.

Thus the institution was compelled to recognise, in the face of much popular protest, what is clearly evident on reflection, both from *a priori* argument and from common experience, namely, that productive research, like any other constructive work, requires arduous, persistent, and, above all, sustained effort under the direction of disciplined experts. Coruscations in science occur frequently enough, but unfortunately most of them, as every investigator knows, are *ignes fatui*. It is more rational, therefore, in the interests of progress to provide for continuity in research than to give special attention to the excessively rare events of sudden discoveries and inventions which prove to be of permanent value. These advances *per saltum* will take care of themselves; but the surer and more rapid process of general advance, and the one on which attention should be concentrated, in order to build for the future as well as for the present, is the process of summation of increments of knowledge, each relatively infinitesimal in comparison with the possible aggregate.

Science is unable to assign an epoch for the beginning of research and may not venture to predict an end thereof; it may assert confidently only that its methods, which have proved effective and trustworthy in the past, will prove still more effective and trustworthy in time to come.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—The project of establishing a chair of Russian language in the University is now on the way to realisation. The Birmingham Chamber of Commerce has issued an appeal to its members for contributions to a fund for the endowment of such a chair, and of the sum of 12,000*l*., which is aimed at, more than half has already been promised. It is significant that the list of donations includes handsome contributions from Wolseley Motors and Electric Ordnance Accessories Company and the Birmingham Small Arms Company, together with Lloyd's Bank and the London, City and Midland Bank. The realisation by such firms of the help which the University can give to the fostering of commercial relations with Russia augurs well for the early success of the scheme.

The *Times* reports that the Government has set up a Royal Commission to inquire into the co-ordination of the work of the three Welsh University Colleges and the University of Wales.

The Teachers' Registration Council announces that the meeting which was to have been held in the Caxton Hall to-morrow, April 14, is unavoidably postponed, as Mr. Arthur Henderson, President of the Board of Education, now finds that it will be impossible for him to speak on that day. It is expected that the meeting will be held soon after the Easter vacation. The exact date will be announced in due course.

The Executive Committee of the City and Guilds of London Institute has appointed Prof. G. T. Morgan, F.R.S., of the Royal College of Science, Dublin, to the chair of chemistry at the Institute's Technical College, Finsbury, rendered vacant by the death of Prof. Meldola. Prof. Morgan was a former student at the college under Prof. Meldola, and later for some years chemist in the works of Messrs. Read, Holliday and Sons. He is a recognised authority on synthetic chemistry and dye-stuffs, on which subjects he has published many original papers. He will take up his duties at the college after Easter.

It is announced in the *London University Gazette* that a course of five lectures and demonstrations on "Some Vegetable Products of Economic Importance" will be given by Mr. A. W. Hill, at the Royal Botanic Gardens, Kew, at 11 a.m. on Saturdays, beginning on May 6. The lectures will deal with some of the better-known economic plants and their products, such as tea, cinchona, cacao, rubber-yielding plants, oil-yielding plants, etc. The lectures, which will be illustrated by means of specimens from the living collections at Kew and also by examples of the products referred to from the museums, will be addressed to advanced students of the University and to others interested in the subjects dealt with. Admission is free, without ticket.

The 360,000*l*. of "University Building Bonds" voted by the people of California for additional building work at the University of California have, we learn from *Science*, been allocated by the regents of the University as follows:—Benjamin Ide Wheeler Hall, a class-room building with a capacity of 3500 students, its exterior to be of white granite, 140,000*l*.; completion of the University library, of which the present portion was built at a cost of 168,000*l*., 105,000*l*.; second unit of the group of agricultural buildings, 70,000*l*.; first unit of a group of permanent buildings for chemistry, 32,000*l*.; new unit for the heating and power plant, 14,000*l*.; furnishings and equipment for the four structures first mentioned, 26,800*l*. Our contemporary also states that the Committee on Agriculture of the Massachusetts Legislature has obtained the full grant of 76,400*l*. asked for new buildings this year by the Massachusetts Agricultural College.

The President of the Board of Education has appointed a Departmental Committee to consider what steps should be taken to make provision for the education and instruction of children and young persons after the war, regard being had particularly to the

interest of those :—(i) Who have been abnormally employed during the war; (ii) who cannot immediately find advantageous employment; (iii) who require special training for employment. The committee consists of :—Mr. Herbert Lewis, M.P., Parliamentary Secretary, Board of Education (chairman); Mr. W. A. Appleton, secretary, General Federation of Trade Unions; Mr. R. A. Bray, L.C.C., chairman, London Juvenile Advisory Committee; Mr. F. W. Goldstone, M.P.; Mr. Spurley Hey, director of education, Manchester; Alderman Hinchcliffe, chairman, West Riding County Council; Miss C. Martineau, member, Birmingham City Council; Lady Edmund Talbot; Mr. H. M. Thompson, vice-chairman, Cardiff Education Committee; Mr. Christopher H. Turnor, member, Lincolnshire (Lindsey) County Council; together with the following representatives of the Government Departments concerned :—Mr. C. E. B. Russell, of the Home Office; Mr. J. S. Nicholson, of the Board of Trade; Mr. A. B. Bruce, of the Board of Agriculture; Mr. E. K. Chambers, C.B.; and Mr. F. Pullinger, C.B., of the Board of Education. Mr. J. Owen, H.M. Inspector, will act as secretary to the committee, and all communications should be addressed to him at the Board of Education, Whitehall, London, S.W.

The question of the part science should take in the education provided in our schools and colleges is further discussed in the correspondence columns of the *Times* Educational Supplement of April 4. Mr. C. L. Bryant, of Harrow, describes how the organisation of the Association of Public Schools Science Masters has been employed to introduce in many of the public schools instruction in science of a utilitarian kind along the lines suggested by the Director of Military Training, not only to those boys who would be learning science if times were normal, but also to all boys who are within measurable distance of leaving to join the Army. Prof. Percy Gardner comments on the recent memorandum on the neglect of science. His position is clear from the following paragraph from his letter :—"I am no hard-and-fast defender of the classics. I should allow that in the teaching of the sciences which deal with nature as well as in the teaching of those which deal with man, and with language and history, we need more scientific method, more system, more modernity. And the natural and human sciences may well claim in the future some of the time now given to the classics. Some knowledge of the scheme of the physical universe has become a part of all complete education. But premature specialism in natural science is not a desirable thing; and that would be the inevitable result of such impatient legislation as the memorial demands." Mr. R. W. Livingstone attributes the scientific success of Germany to the admirable provision for the teaching of applied science in her Technische Hochschulen, to the fact that many more people receive a university education in Germany than is the case with us, and that in Germany research work is an essential part of a university education for the best students. Mr. H. Cradock-Watson, writing of the position of science in the smaller schools, maintains that science has its proper place in their time-tables already, and that when the commercial and manufacturing worlds are ready to employ and pay adequately the university science graduate, when the scientific expert can command the remuneration and the openings that he can —or could—in modern Germany, then the teaching of science will come into its own. Mr. O. H. Latter directs attention to the discontinuance of a science paper in the common entrance examination for public schools, and the consequent discouragement of science teaching in preparatory schools.

SOCIETIES AND ACADEMIES.

London.

Royal Society, April 6.—Sir J. J. Thomson, president, in the chair.—J. H. **Jeans**: The instability of the pear-shaped figure of equilibrium of a rotating mass of liquid. The form of the pear-shaped figure of equilibrium was calculated so far as the second order of small quantities by Sir G. Darwin, who believed he had shown it to be stable. In a recently published paper (Phil. Trans., A, 215, p. 27) it was shown that the stability could only be finally decided upon after the figure had been calculated to terms of the third order. In the present paper these third-order terms are evaluated, and the pear-shaped figure is definitely shown to be unstable.—Sir William **Ramsay**: A hypothesis of molecular configuration in three dimensions of space.—J. **Proudman**: The motion of solids in a liquid possessing vorticity. This paper contains investigations on the motion of a homogeneous frictionless liquid by the methods of theoretical hydrodynamics. The principal subjects considered are two-dimensional motion with uniform vorticity and three-dimensional motion with varying vorticity, the positions of the solids being specified by generalised co-ordinates. The general work consists in reducing solutions to those of Neumann's potential problems.—Dr. S. J. **Lewis**: The ultra-violet absorption spectra of blood sera. The work described in this preliminary paper has for its object the investigation of the absorption spectra of blood sera in the ultra-violet region of the spectrum. Modern spectrophotometers are used to determine the absorption values on passing ultra-violet light through a prescribed layer or solution of serum. With these values as ordinates and wave-lengths as abscissæ an absorption curve is drawn. With normal serum the general characters of the curve are constant, and there is very little variation in detail. With certain pathological sera the curves show much greater modifications, and some of these are well defined and appear to be peculiar to given diseases. It is found that the major part of the absorption is due to the proteins.—G. W. **Paget** and R. E. **Savage**: The growth-rings on herring scales. This communication brings forward morphological evidence as to the structure and significance of the so-called "growth-rings" on herring scales. At present the interpretation of these rings as rings of growth depends, in the main, upon statistical data. Morphological evidence of a differential growth-rate of the scale as a whole is altogether lacking. The present observations place upon a sure foundation the view that the transparent rings do indeed, mark a recurring period of minimum growth.

Geological Society, March 8.—Dr. Alfred Harker, president, in the chair.—H. **Bolton**: Fossil insects from the British Coal Measures. The author describes six insect-wings found in the Coal Measures of Northumberland, Lancashire, and South Wales. Three of these have been previously named, but not described in detail; the remaining three are new to science. *Aedoeophasma anglica*, Scudder, has been examined in detail, and is now regarded as a primitive type of the Proto-Orthoptera, in contradistinction to Scudder's view that it is a Protophasmid, and to that of Handlirsch, who had removed it to a group of unplaced Palæodictyoptera. *Palaeodictyopteron higginsi* is shown to be related to the Dictyoneuridæ. A new genus and species is created for a finely-preserved wing, intermediate in character between the Dictyoneura and Lithomantis. Among the varied fauna obtained from ironstone nodules in the Middle Coal Measures at Sparth Bottoms, Rochdale (Lancashire), is a basal fragment of a wing recognised as a new species of Spilaptera, and this is now described. An

unusual type of wing from the Northumberland Coalfield is very suggestive of the Protodonata, and is described as a representative of a new genus and species.

Aristotelian Society, March 8.—Dr. H. Wildon Carr, president, in the chair.—T. Percy **Nunn**: Sense data and the physical object. A criticism of the view that physical objects are revealed in perception as existences of which we have immediate knowledge that they are the "sources" of our sense data. The author contended that the "source" is not in truth an "existence" beyond the sense data, but includes the whole collection of such sense data as can be directly apprehended by perceiving subjects under different conditions. Nothing is gained in simplicity and naturalness by invoking admittedly hypothetical "sources" in order to say about them something formally identical with what must in any case be said about indubitable sense data. For instance, the assumption of a "source" in order to explain why we attribute real shape to an object creates more embarrassment than it removes, for, while it may account for the sense data which resembled the "source" in shape, it affords no help in accounting for those that do not. The contention that sense data carry with them a reference to a "source," or always indicate a reality beyond themselves, breaks down when the attempt is made to deal with the problem of hallucination and error. The physical theory of matter does not necessitate the assumption of a "source"; for the molecules (and atoms) of matter are simply the molar bodies of everyday experience conceptually reduced in size. Whatever belongs to the latter may belong to the former also.

EDINBURGH.

Royal Society, March 6.—Dr. J. Horne, president, in the chair.—Prof. F. O. **Bower**: Leaf architecture as illuminated by a study of the Pteridophyta. A knowledge of leaf architecture may be gained (1) by a comparative study of adult leaves in a large number of different types; (2) by a study of the juvenile leaves and of their development towards the adult form; (3) by a further comparison with the fossil record. The first of these avenues has had priority, especially in relation to the higher flowering plants, leading unfortunately to an interpretation of the lower in terms of the higher. A careful study of the juvenile leaves of the Pteridophyta show that all the varied forms of leaf can be explained as a modification through growth of an original simple dichotomy. The dichotomy in juvenile leaves may be equal or unequal. In the latter case the system is commonly developed sympodially, and all gradations may be observed. This is well illustrated in Pteridium and Osmunda. The order of ontogenetic development is normally from equal dichotomy to sympodial dichotomy, and when the development of the leaf is strong there may be transition to monopodial branching. In higher vascular plants, after the arrest of apical growth, the most prominent factor is intercalary growth. This is effective in producing the petiole. A number of comparisons were instituted which indicated, as a general statement for vascular plants, that their leaf architecture is throughout referable to modifications of a branch system originating phyletically in a simple leaf subject to dichotomy.

PARIS.

Academy of Sciences, March 27.—M. Ed. Perrier in the chair.—The president announced the death of Léon Labbé, free member of the academy, at the age of eighty-four, and gave an account of his work in surgery.—A. **Blondel**: Remarks on the use of high potential continuous current for wireless telegraphy and telephony. With reference to a recent communication to the academy on this subject by MM. Girardeau and Béthenod, it is pointed out that the energy losses are greater than those calculated from the equations employed by Fracque. There are also practical difficulties connected with the use of high-tension continuous current, not present to the same extent when alternating current is used.—Lester R. **Ford**: The approximation of irrational complex quantities.—A. **Buhl**: Geometrical applications of Abel's theorem and Stokes's formula.—G. H. **Hardy**: The summation of Dirichlet's series.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the fourth quarter of 1915. Observations were made on sixty days, the results being given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Louis **Roy**: The electrodynamics of absorbent media.—L. **Reutter**: The analysis of a Roman pomade. This pomade was found in a Roman amphora excavated near Lugano, and was found to consist of a mixture of beeswax and other fats, added to styrax and turpentine macerated in wine, with some henna.—Paul **Gaubert**: The growth of crystals. Remarks on a recent communication of C. Dauzère. The crystallisation of thymol under the microscope is periodic.—M. **Deprat**: Cycles of erosion and recent epeirogenic movements in south-western China.—Adrien **Guébhard**: The extension north of the department of Var of the tectonic formula of the neighbourhood of Castellane (Basses-Alpes), and the generalisation of its principle.—A. **Brives**: The relations of the Trias and metalliferous deposits in Algeria.—P. **Chaussé**: Researches on the persistence of Botal's cleft in some domestic animals. This malformation was found in 30 per cent. of the three months old calves examined, and was also common in grown cattle and in pigs. It was exceptional in the horse and dog.—A. **Lécaillon**: The existence of two annual generations in *Galeruca luteola*, and on the manner in which they succeed each other.—A. **Magnan**: Vaccination against paratyphoid fevers A and B.—A. **Trillat**: A calorimetric method utilised by the Romans for characterising soft waters. The Romans attached considerable importance to the quality of their drinking water, and appear to have chosen the softest water when more than one supply was available. From a remark by Hippocrates it seems that the bleaching of small quantities of red wine by the water was the test employed. It is shown that a series of nine waters is arranged in the same order of hardness by testing with wine or by the ordinary alkali-metric method.

BOOKS RECEIVED.

The Moon, considered as a Planet, a World, and a Satellite. By J. Nasmyth and J. Carpenter. Cheap edition. Pp. xix+315. (London: J. Murray.) 2s. 6d. net.

Guida Allo Studio della Storia delle Matematiche. By Prof. G. Loria. Pp. xvi+228. (Milano: U. Hoepli.) 3 lire.

A Treatise on Electricity. By F. B. Pidduck. Pp. xiv+646. (Cambridge: At the University Press.) 14s. net.

The Fauna of British India, including Ceylon and Burma. Rhynchota. Vol. vi., Homoptera: Appendix. By W. L. Distant. Pp. viii+248. (London: Taylor and Francis.) 10s.

The Flowering Plants of Africa. By Fr. Thonner. Pp. xvi+647. (London: Dulau and Co., Ltd.) 15s. net.

Natural History of Hawaii. By Prof. W. A. Bryan.

Pp. 596. (Honolulu: The Hawaiian Gazette Co., Ltd.)

Memoirs of the Geological Survey. England and Wales. On the Thicknesses of Strata in the Counties of England and Wales, exclusive of Rocks older than the Permian. By Dr. Strahan, and others. Pp. vi+172. The Geology of the South Wales Coalfield. Part xii., The Country around Milford, being an account of the region comprised in Sheet 227 of the Map. By T. C. Cantrill, and others. Pp. vii+185. (London: H.M.S.O.; E. Stanford, Ltd.) 4*s.* 6*d.* and 2*s.* 6*d.* respectively.

The Sex Complex. By Dr. W. Blair Bell. Pp. xvii+233. (London: Baillière, Tindall, and Cox.) 12*s.* 6*d.* net.

Physiological Chemistry. By Prof. A. P. Mathews. Pp. vi+1040. (London: Baillière, Tindall and Cox.) 21*s.* net.

Brook and River Trouting. By H. H. Edmonds and N. N. Lee. Pp. 106. (Bradford: The authors.) 10*s.* 6*d.* net.

On the Relation of Imports to Exports. By J. Taylor Peddie. Second edition. Pp. xxiv+148. (London: Longmans and Co.) 5*s.* net.

Occupations: from the Social, Hygienic, and Medical points of View. By Sir T. Oliver. Pp. x+110. (Cambridge: At the University Press.) 6*s.* net.

The Dynamical Theory of Gases. By J. H. Jeans. Second edition. Pp. vi+436. (Cambridge: At the University Press.) 16*s.* net.

Records of the Survey of India. Vol. vii. Annual Reports of Parties and Offices, 1913–14, from 1st October, 1913, to 30th September, 1914. Prepared under the direction of Sir S. G. Burrard. Pp. ii+180+11 maps. (Calcutta: Superintendent Government Printing, India.) 4 rupees, or 6*s.*

Union of South Africa. Mines Department. Geological Survey Memoir No. 7: The Geology and Mineral Industry of South-west Africa. By P. A. Wagner. Pp. 234+plates xli. (Pretoria: Government Printing and Stationery Office.) 7*s.* 6*d.*

Forty-fifth Annual Report of the Deputy Master and Comptroller of the Mint, 1914. Pp. 191. (London: H.M.S.O.; Wyman and Sons, Ltd.) 3*s.* 6*d.*

An Introductory Course of Continuous Current Engineering. By Dr. A. Hay. Second edition. Pp. xii+360. (London: Constable and Co., Ltd.) 6*s.* 6*d.* net.

Wisconsin Geological and Natural History Survey. Bulletins Nos. xxviii.–xxxii. Soil Series, Nos. 2–6; Bulletins Nos. xxxvii+xl. Soil Series, Nos. 7–10; Bulletins Nos. xxxv and xliv. Economic Series, Nos. 17 and 19. Soil Maps, accompanying Bulletins 28 to 32 and 37 to 40 inclusive. Soil Series, 2 to 6 and 7 to 10 inclusive. (Madison, Wis.: Published by the State.)

Economics: an Introduction for the General Reader. By H. Clay. Pp. xvi+476. (London: Macmillan and Co., Ltd.) 3*s.* 6*d.* net.

Medical and Veterinary Entomology. By Prof. W. B. Herms. Pp. xii+393. (London: Macmillan and Co., Ltd.) 17*s.* net.

DIARY OF SOCIETIES.

THURSDAY, April 13.

Institution of Electrical Engineers, at 8.—*Discussion:* The Present Position of Electricity Supply in the United Kingdom; and the Steps to be taken to Improve and Strengthen it.

Child Study Society, at 6.—Experiments on Hand-writing in Schools: Dr. C. W. Kimmins, Mrs. Grainger, and Miss Golds. At 7.30.—Annual Meeting.

Institution of Naval Architects, at 11 a.m.—Subdivision of Merchant Vessels: Reports of the Bulkhead Committee, 1912–1915: Sir Archibald Denny.—Strength of Watertight Bulkheads: J. F. King.—Some Effects of the Bulkhead Committee's Reports in Practice: A. T. Wall. At 3.—Notes from a Collision Case: J. Reid.—Shipyard Cranes of the Rotterdam Dockyard Company: M. G. de Gelder.

Royal Geographical Society, at 5.—Night Marching by Stars: E. A. Reeves.

Optical Society, at 8.—Practical Workshop and Laboratory Measurements: S. D. Chalmers.—Some Further Notes on Focometry: T. F. Connolly.

FRIDAY, April 14.

Royal Institution, at 5.30.—The Genesis and Absorption of X-Rays: Sir J. J. Thomson.

Institution of Mechanical Engineers, at 6.—Theory and Practice in the Filtration of Water: W. Clemence.

Royal Astronomical Society, at 5.—Observations of the Double Star Krueger 60: E. E. Barnard.—The Kinetic Energy of a Star Cluster: A. S. Eddington.—Catalogue of Radiant Points of Shooting Stars, 1898–1915: A. King.

Physical Society, at 5.—The Variation of Resistance with Voltage at a Rectifying Contact of Two Solid Conductors, with Applications to the Electric Wave Detector: D. Owen.—The Electrical Capacity of a Gold Leaf Electroscope: Dr. T. Barratt.

SATURDAY, April 15.

Royal Institution, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

MONDAY, April 17.

Royal Geographical Society, at 8.30.—The Development of Rhodesia from a Geographical Standpoint: H. Wilson Fox.

TUESDAY, April 18.

Royal Statistical Society, at 5.15.

Zoological Society, at 5.30.—The External Characters of the Mongooses (Mungotidæ): R. I. Pocock.—The Poison-Organ of the Sting-Ray (*Trygon pastinaca*): Major H. Muir Evans.

Institution of Civil Engineers, at 5.30.—Annual General Meeting.

WEDNESDAY, April 19.

Royal Microscopical Society, at 8.—Early Stages in the Evolution of Life: Prof. Benjamin Moore.—Studies in Marine Biology: F. Martin Duncan.—Some Suggestions regarding Visual Efficiency in the Use of the Microscope and other Optical Instruments: J. W. Purkiss.

Royal Meteorological Society, at 7.30.—The Persistence of Wet and Dry Weather: E. V. Newnham.—Discontinuities in Meteorological Phenomena. Second Note. Prof. H. H. Turner.

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THURSDAY, APRIL 20, 1916.

GEMS AND SUPERSTITION.

The Magic of Jewels and Charms. By Dr. G. F. Kunz. Pp. xv+422. (Philadelphia and London: J. B. Lippincott Co., 1915.) Price 21*s.* net.

DR. KUNZ, who is well known as a mineralogist of repute and as one of the leading authorities of the day on precious stones and jewelry, has evidently spared no time and trouble to make himself acquainted with the many strange fancies and superstitions that have at various times and in various countries been attached to gems and other treasured objects. As the result of his industry he had compiled a large mass of notes, out of which he gave us barely two years ago a book entitled "The Curious Lore of Precious Stones," and now, since his stock of material was by no means exhausted by the publication of that work, he sets before us a companion volume, or, as he terms it in his preface, the twin sister, the scope of which is much more diffuse; precious stones enter again, especially as regards their curative and talismanic uses, but besides them we ind also substances which do not ordinarily figure n jewelry, such as meteorites, fossils, bezoars, nd animal concretions. Founded as it is upon iotes, and copiously sprinkled with lengthy exracts from the original literature, the book proeeds with something of the jerky gait of the rasshopper, and we find nothing in the way of a eneral discussion or the development of some omprehensive theory. Nevertheless, the author as done good service by providing a good and nvenient *résumé* of the subject, and not the least aluable and interesting paragraphs are those in hich he gives the results of his own observaons.

In the first chapter, on magic stones and electric ems, the author touches upon some curious ones. He considers that galactite, which accordg to Pliny came from the Nile and had the colour d odour of milk, was not, strictly speaking, a one at all, but nitrate of lime. Rain-makers, ho professed to produce rain by their magic art, em to have made use of any unusual stone that ppened to come to hand, and, although rockystal has been so employed, transparent stones ere by no means the rule. In medieval times untless attempts were made by the alchemists to scover the so-called philosopher's stone, which ould transmute base metal into gold, and the norant people of those days were often successlly imposed upon. A description is given of the ost striking examples of the supposed transutation that have come down to us, viz., the ge medallion, bearing in relief the heads of the nperor Leopold and his ancestors of the house of psburg, which was treated by Seiler in 1677, d the exceedingly rare medal struck in 1647 by nmand of the Emperor Ferdinand III. from ld supposed to have been produced in his presce by Hofmann; in neither case, of course, is the metal pure gold, but it remains a mystery what was the actual process, the historical interest of the objects precluding a chemical examination. The remarkable electric properties of tourmaline, in which respect it transcends other minerals, first attracted notice as early as 1717, and were definitely established by 1756. Dr. Kunz describes in appreciative terms the beautiful examples of this mineral that have come from Brazil and California, and bases upon them somewhat extravagant symbolism; thus as regards the "peace stones"—the well-known tourmaline crystals, red and green at opposite ends with a colourless band in the middle—he writes: "We can see symbolised in them the great and consoling fact that, however marked may be the differences between any two peoples, they need not be cause for enmity, but may instead become true and enduring sources of peace and bonds of union." The electric properties of amber were, of course, a much earlier discovery, dating back to 600 B.C. That the wearing of a necklace of this substance kept off attacks of erysipelas in a person subject to them was maintained by the late Rev. C. W. King, the well-known writer on precious stones; the author quotes his actual words: "Its efficacy in defence of the throat against chills is evidently due to its extreme warmth when in contact with the skin and the circle of electricity so maintained."

In the chapter on meteorites the author draws for his description of the earlier falls largely upon Chladni, who was the first writer to make a systematic study of the numerous traditions of such phenomena, and to suggest a doubt in the minds of the scientific world whether they should be dismissed as idle fables. The more famous of the historical stones include the Phrygian stone, which was conveyed to Rome in 204 B.C., the Diana of the Ephesians "which fell from Jupiter," the Kaaba stone at Mecca, and the stone which fell at Ensisheim in Alsace on November 16, 1492. We note that Dr. Kunz speaks of the collection of meteorites at Vienna as the finest in the world, which is possibly true, but we may remark that the one in the Natural History Museum, London, is practically equal to it, and contains the large Cranbourne stone, weighing about 3½ tons. Descriptions and illustrations are given of the three enormous masses discovered by Admiral, then Lieut., Peary in 1894 near Melville Bay, West Greenland, and a few years subsequently removed by him to the American Museum of Natural History, New York, weighing respectively 36½ tons, 3 tons, and 1100 lb.; they have been named the Ahnighito, the Woman, and the Dog.

It may strike many readers as strange to read that even as late as the middle of the eighteenth century powdered hard stones were still in use for medicinal purposes; thus in a druggist's price-list dated 1757 a pound of emerald is quoted at eight groschen (5*l.*), of sapphire at double, and of ruby at treble that amount. The author gives lengthy details of the supposed virtues of the various gemstones, the species being arranged in alphabetical order, and devotes a couple of chapters to the

curative properties of fabulous stones, and of the mysterious bezoars, which were thought to have originated in the eyes of deer, in the liver of various animals, or in similar strange ways. The use of precious stones in religious ceremony goes back to a very early date, and still prevails. The instance of the High Priest's breastplate of the ancient Jews is well known, and identification of the stones composing it has given rise to much interesting discussion. A long chapter is devoted to the description of amulets in ancient and modern times, and in the concluding chapter Dr. Kunz has collected many strange stories about precious stones. As an unusually brilliant imaginative effort we may select the old Burmese legend of the origin of the famous ruby mines: "In the first century of our era three eggs were laid by a female *naga,* or serpent; out of the first was born Pynsacoti, a king of Pagan; out of the third came an Emperor of China; and out of the third were emitted the rubies of the Ruby Mines."

The book is superbly illustrated and well printed, and contains an adequate index.

A BIOGRAPHY OF EDISON.

Thomas Alva Edison. By F. Rolt-Wheeler. Pp. ix+201. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 2*s.* net.

IN this life of Thomas Alva Edison, the author has given a very interesting description of the childhood, youth, and manhood of America's —one might almost say, the world's—greatest living inventor. We learn that, as a boy, Edison proved unsatisfactory under school routine, but was a great success under his mother's private tuition. He incessantly asked questions on and about everything, and insisted on an answer or wanted to know the reason "why." He also showed, from the earliest records, that he was a keen thinker, worker, and planner on all work which interested him, but under "routine" of any kind he was a complete failure.

The account of Edison as a newspaper boy on the Grand Trunk Railroad, and his original methods of disposing of his papers, as well as the description given of his services as a telegraph operator, illustrate the extraordinary ingenuity of the youth. He seems to have an uncanny foresight or "guessing power," as he calls it. He is no mathematician, and declared "he could guess a good deal closer than they could figure." In later years, as he developed his inventions one by one, he collected a number of valuable and enthusiastic assistants. He inherited from his father an exceptional power of gaining the confidence of people in his work and their financial support.

Edison's first important invention was the vote-recorder, which he placed before Congress men, who examined and acknowledged that it was a great success, but thought it was not required. This was a severe shock to the inventor, who at the time was hard up for money and hoped to make something out of it. But it taught him lesson; "for there and then he made up his mi never to waste time in inventing things wh were not wanted." Later he became manag of the Law Gold Recording Company, and vented many improvements on their instrumen At this time he married, but he denies the sto that "he forgot his wife an hour after his we ding." He later became connected with t Western Union Telegraph Company, which ga him every help in completing his inventio Among these are the duplex and quadruplex te graphy, also the telephone carbon transmitt and numerous other inventions well known to a

On one occasion Edison was asked, "What a genius?" and his answer is well worth repe ing. "A genius is about 2 per cent. inspirati and 98 per cent. perspiration." His part in t construction of the carbon filament lamp (whi was not entirely his work, for the late Joseph Swan had much to do with it) is w known, as also in the production of the phon graph, which may be considered the most wond ful of all his inventions, and will always be ass ciated with his name. Of his recent inventio the storage battery is of enormous importan especially to England at the present time. is impossible to give more than a rough impre sion of his wonderful energy and enthusiasm a his determination to master all problen America and the world are richer and wiser his genius; and though he is now sixty-sev years of age, we hope that he will not only rea but also pass, in activity, the great ages of father and grandfather.

S. G. BROWN.

THE DESIGN OF DIESEL ENGINES F MARINE PURPOSES.

(1) *Land and Marine Diesel Engines.* By Supino. Translated by Eng. Lieut.-Comm der A. G. Bremner and J. Richardson. Pp. x 309. (London: C. Griffin and Co., Ltd., 19 Price 12*s.* 6*d.* net.

(2) *Diesel Engines for Land and Marine W* By A. P. Chalkley. Fourth edition, revised enlarged. Pp. xvii+368. (London: Const and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

JUDGED from the titles given above, it m be supposed that these two recently lished treatises on the Diesel engine covered same ground, but a careful perusal will show the ideas of the authors are by no means ident and as a result it may be predicted that altho both volumes will appeal to all engineers others who have to do with internal combus motors and motive power for the propulsio ships, the first of the above two books is one will find its way into the reference departme every drawing office where Diesel engines marine purposes are being designed, whilst second book, by means of its description o gradual development of the Diesel engine fro early experimental engines of Dr. Rudolph D down to the modern practice of to-day, will a

more to the student of heat engines and the prospective user of this particular type of prime mover.

(1) The keynote to the first volume is undoubtedly the explanation of the actual designing of the marine Diesel engine and its component parts, and it seems quite wonderful that modern practice has so rapidly become to a large extent standardised. The translation from the original has evidently been undertaken by engineers skilled in the practice of their profession and in sympathy with the subject-matter of the text. The original treatise is the work of an Italian specialist in the development of the Diesel motor, Giorgio Supino, whose early decease is a real loss to Italian engineering. Naturally the reader will ask what has this eminent foreign author to say about British-made Diesel engines and British manufacturers; at the end of part i., page 72, is a table giving a list of ships and the types of engine adopted, viz., high speed, low speed, 4 cycle, and 2 cycle, and it is noticeable that one only out of some twenty names is that of a British firm.

This surely is a matter which vitally concerns a nanufacturing country such as ours. Recollections of the early years of the petrol motor and notor-car industry and a comparison with the tate of our present manufactures makes one evoutly hope that history will repeat itself and hat full advantage will be taken of the experience nd experimental labours of our Continental cometitors, so that the supply for our colonies may ome from this country. No discussion on the ierits of Diesel engines can be entered upon withut reference to that class known as semi-Diesel, hich latter are perhaps better termed hot-bulb ngines. It is good to think that our output of iese is more satisfactory, but the magnitude of ie units employed of this class is small compared ith that of engines of the Diesel type. It is so good to remember that the engine called semiiesel is in reality the direct outcome of the work an English engineer, Mr. Stuart Akroyd, whose me is associated with the firm of Messrs. ornsby and Sons, Ltd., in the production of the ornsby-Akroyd engine, and it would therefore em a better name for this type of engine that should be termed "engines working on the kroyd cycle," rather than "semi-Diesel."

A brief review of the first book shows that rt i. deals with a general survey of the types of engines in general use, with a discussion on iciencies. Chapter vi. gives methods of calcuing cylinder dimensions; this is succeeded by apters dealing with the designs of various parts, ch as bed-plates, crank cases, engine framing, nk-shafts, pistons, cylinder heads, valves, fuel ection and regulation, etc., all very clearly strated by excellent drawings and plates. thods of reversing marine engines give up-tode practice, and it is startling to realise that the ole cycle of reversing can be performed in seconds. A final chapter deals with trials and ts of Diesel engines. It would be a help if a ulated form of "report on a trial" were included, as standardisation is very desirable in any form of comparative tests. From this short review it would appear that the subject-matter is really the complete design of Diesel engines for marine purposes, and as such it is a meritorious addition to engineering literature.

(2) The second volume is a greatly enlarged and much rewritten edition of a work which first appeared in the spring of 1912, almost contemporaneous with the last public appearance of Dr. Diesel in London. The defects of the first edition (which bore traces of hurried preparation) have disappeared, and we now have a copiously illustrated and enthusiastic survey of the progress of the Diesel engine, with many examples of modern types for land and marine installations, and an optimistic claim for its future development as the prime mover for mechanical transport. In this volume are upwards of forty-five folded plates, which give the main dimensions and cross-sections of the chief types of engines constructed. It is satisfactory to note that British types figure more prominently in this book. One of these, viz., the Tanner-Diesel, is shown on page 264. The writer remembers the early struggles of Mr. Tanner to get his designs taken up, and is glad to pen this tribute to his faith and earnestness in carrying through his designs to a successful issue in the face of great difficulties. It will be noticed that the progress made in the last four years has been mainly in the development of the two-stroke cycle type, and the increase of h.p. developed per unit employed. A perusal of the table on page 317 shows that the maximum diameter of cylinder is now 30 inches, and that the maximum h.p. per cylinder is 650 for a 2-cycle engine, but the average h.p. per cylinder is only 230 for this class, and for the 4-cycle slow-speed type the average is only 125 h.p. per cylinder, a figure which represents the performance of the *Selandia*, the boat Londoners had a chance to inspect whilst she was lying in the Thames in 1912. The figures given justify the claim of the author of this book that the 2-stroke cycle is that of the future. To the student and others who desire to understand this engine and its working this volume will be of great service.

It would be interesting to refer to the development of the Diesel engine and its use to extend submarine warfare, but the present is not opportune for any remarks on this point. A. J. M.

OUR BOOKSHELF.

Instincts of the Herd in Peace and War. By W. Trotter. Pp. 213. (London: T. Fisher Unwin, Ltd., 1916.) Price 3*s*. 6*d*. net.

AN interesting and useful sociological survey. The author contends that the subject can really become a science, practically useful by conferring foresight. It is not necessarily only a mass of dreary and indefinite generalities, but may become a guide to the actual affairs of life, giving an understanding of the human mind which may en-

able us to foretell some of the course of human behaviour. The war brings the chance of testing the truth of this suggestion. It is becoming, obviously, more and more a war of moral forces; and an understanding of the nature and sources of national *moral* must be as important a source of strength as the knowledge of the military engineer.

The author proceeds to discuss the various forms of gregariousness, and finds the British form typified by the bee, the German form by the wolf. The difference is so great that the war is not so much a war between nations as a war between different species. Nature is making one of her great experiments; is setting herself to try out the strength of the socialised and the aggressive types. To the socialised peoples she has entrusted the task of proving that her old faith in cruelty and blood is at last an anachronism. To try them, she has given substance to the creation of a nightmare, and they must destroy this werewolf or die. And a calm consideration of the German and the British mind leaves us in no doubt where the strength lies. In Britain there has been no Hymn of Hate, no "God punish Germany!", no gospel of bluster and frightfulness. These are symptoms of lupine rage. But Britain, fighting for existence and for honour, has quieter and deeper vision; and she will not sheathe the sword until her task is done, and a peaceful Europe once more possible, freed from the terror of imminent wanton attack by an aggressive Power.

British Fungi and How to Identify Them. By J. H. Crabtree. Pp. 62. (London: C. H. Kelly, n.d.) Price 1s. net.

OUR native fungi afford beautiful objects for the photographer, and have been well illustrated in the many popular and scientific works which deal with them. In the little book before us Mr. Crabtree illustrates some forty different species of well-known fungi by means of very good photographs, and each photograph is accompanied by a page of useful descriptive text. By the aid of both text and illustration a particular fungus should be able to be identified without much difficulty. In the case of the somewhat small differences between certain edible and poisonous fungi the ordinary photographic reproduction is not sufficiently clear to show the distinguishing features, and a few good colour prints would have been of value.

In a short introduction of four pages the author gives a concise account of the larger fungi in general—with which only this little book is concerned—details as to the spore-arrangement, etc., and a simple classification. It is unfortunate that Mr. Crabtree's frontispiece, "An unnamed fungoid growth found upon a tree," is not a fungus at all, but is what is known as a "wood flower." This hollow woody growth has been gradually formed about the suctorial portion of some parasitic plant, probably a Loranthus, which has become detached and has left a large tulip-shaped woody scar resembling a fungus on the branch of its host plant.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Primary Sugar of Photosynthesis.

MICROCHEMICAL tests on the assimilating cells of several plants indicate a considerable concentration of hexoses in the chloroplasts, or in the protoplasm immediately surrounding them. Other lines of experiment suggest that while sucrose is concentrated in the large vacuoles, invertase is held apart from it in the protoplasm.

These facts force upon one the possibility that the pioneer analytical work of Brown and Morris established and extended by Parkin and by Davis and his collaborators, does not after all necessitate the conclusion that the formation of sucrose is a preliminary step to the production of hexoses in the leaf.

It seems more probable that the hexoses are formed from formaldehyde in the chloroplast, and, when their concentration reaches a certain limit, condensation into sucrose due to invertase, or some saccharogenic enzyme, takes place. The sucrose thus formed is passed into, and stored in the vacuole. As the volume of the protoplasm available for the hexoses is small compared to the space allotted to the sucrose, the increase of the total percentage of hexoses will be small when the leaf is exposed to light, while that of the sucrose will be large. Consequently the rise of sucrose on illumination shown in analyses of leaves is not a cogent argument for regarding it as the primary sugar.

The recognition of the localisation of various substances in the cell also supplies an explanation as to how the sucrose-hexose ratio of the cell is maintained in presence of invertase. The absence of invertase from, and the storage of sucrose in the vacuole may be compared to the conditions obtaining in the root of the sugar beet. Only there, of course, the source of sucrose is secondary hexoses. In photosynthesis the condensation of the sugars is probably determined by the fact that for the same rise of osmotic pressure in the vacuole twice the amount of the disaccharide may be stored. When the limiting pressure is reached in this way the condensation of hexoses to starch may give extended elasticity to the economy of the cell.

HENRY H. DIXON.
THOMAS G. MASON.

School of Botany, Trinity College, Dublin,
April 10.

Isle of Wight Disease in Bees.

DRASTIC recommendations regarding the disinfectio[n] or destruction of combs, hives, and appliances whi[ch] have come in contact with bees infected by Isle [of] Wight disease have been made by the Board of Agri[-] culture, and were repeated in an article in NATURE [of] March 2 (p. 7). The recommendations are found[ed] upon the idea of the infectiousness of the disease, a[nd] are intimately connected with the recognition of t[he] protozoon *Nosema apis* as the cause of the diseas[e] and with the knowledge of the ease by which th[e] parasite can be disseminated by infected bees. [On] account of the practical importance of the subject, [I] would direct attention to the results of experimen[ts] bearing upon these points, carried out by Mr. [...] Anderson and Dr. J. Rennie, of the North of Scotla[nd] College of Agriculture and University of Aberde[en] respectively, and communicated at a recent meeti[ng]

of the Royal Physical Society. As an account of the observations and experiments, which were numerous and detailed, will appear in the next part of the Proc. Roy. Physical Soc., an indication of their bearing is all that is necessary for the present.

(1) As regards *Nosema apis,* the authors have been "unable to recognise any causal relation between the presence of this parasite and the disease." Healthy stocks with no signs of disease have been found to be heavily infected by the protozoon, and that over prolonged periods. Numerous stocks have exhibited unmistakable symptoms of Isle of Wight disease, and yet no trace of Nosema has been found in them. This was markedly the case in the Deeside outbreak. Lastly, deliberate infection of a stock with Nosema did not produce the recognised symptoms of the disease. "Nosema may be a contributing weakening actor, favouring in certain cases the development of his disease, but we have not found that it is an ssential factor."

(2) As regards the infectiousness of Isle of Wight lisease: If it be allowed that Nosema, with its readily ransported spores, is not the prime cause of the lisease, the supporting evidence of infectivity is veakened, and the direct evidences must be examined nore critically. The authors have watched in detail he natural course of Isle of Wight disease in three ndependent localities, and have followed the history of ntainted swarms placed in contaminated hives and ed on contaminated honey. They have found o indubitable evidence of the infectiousness of he disease, although the indications seem to be that is "probably infectious"; but in any case they are ssured that it is "not necessarily conveyed by mere ontact with contaminated hives or combs, or by feed- ng upon contaminated stores."

It is a point of some interest and importance that, n account of the unsatisfactory nature of experiments n a small scale in artificial conditions, the above esults are based on observations and experiments pon hive bees living in natural conditions.

JAMES RITCHIE,
(Hon. Secretary, Royal Physical Society).
Edinburgh.

REGARDING Dr. J. Ritchie's communication, it would em well to await the published paper of Messrs. nderson and Rennie before making detailed remarks. so, as Dr. Ritchie is not the direct author of the per, it is inadvisable to bring in a third party. owever, it is most surprising, to say the least, to arn that "Isle of Wight" bee disease is not con- dered to be infectious. How, then, has the disease read all over Great Britain and most of Ireland ring the last ten years? The statement of the non- fectivity of the disease is emphatically inaccurate. r. Ritchie writes of the "unmistakable symptoms" the disease. But, what are the characteristic mptoms? The investigators working under the ard of Agriculture, in their reports of 1912 and 1913, owed conclusively that there were no well-marked ferential symptoms of "Isle of Wight" bee disease. is was also pointed out in my article in NATURE, d the reason for this is obvious, namely, the limited nge of expression of the bee, as was also mentioned my article. Of the workers contributing to the reports the Board of Agriculture, two were bacteriologists, o were protozoologists, and one was an expert bee- eper. Many field experiments as to the pathogenicity *Nosema apis* were conducted, and the investigators re unanimously of the opinion that "Isle of Wight" disease is microsporidiosis. Apparently Dr. Ritchie d Messrs. Anderson and Rennie have quite over- ked the importance of parasite carriers, a subject which was carefully pointed out in my article and in the Journal of the Board of Agriculture, Supplements Nos. 8 and 10. Healthy carriers of most parasitic diseases are known.

As to "drastic recommendations," the simple elements of sanitation only were suggested, about which there can be no dispute. The destruction of hives was not suggested in my article. Regarding the experiments of Mr. J. Anderson and Dr. J. Rennie, there is no statement in the above letter as to what stages of *Nosema apis* were used by them.

These remarks must suffice for the present. My article was written after ten years' personal investigation of "Isle of Wight" bee disease, in nearly every part of Great Britain. Judging from Dr. Ritchie's letter, the paper of Messrs. Anderson and Rennie appears to contain little but negation. F.

Preventive Eugenics.

THE writer of the valuable article in NATURE of April 6, on the report of the Royal Commission on Venereal Diseases, has given it the title of "Preventive Eugenics," a term for which I am responsible, defining it as "the protection of parenthood from the racial poisons," by which latter I mean all such agents as, injuring the individual, injure also the next generation through him, or her, as parent.

Syphilis is, of course, an example of a racial poison, and your writer's protest against the term "hereditary syphilis" is most welcome to one who has made such protests for many years. As Dr. J. W. Ballantyne has said, the term is "an insult to heredity." It indicates the persistent medical and popular blindness to the ante-natal stage of human life. All syphilis is acquired syphilis, an infection of which the date may be ante-natal, when we inexcusably call it "hereditary," or post-natal, when we call it acquired, the fact being too obvious for even the "idols of the forum" to obscure. The Commissioners should have condemned the false term, and used "ante-natal syphilis" instead.

The point is not only academic. Eugenists who have had no medical, much less obstetrical, experience, unaware of the fallacy involved, have assumed much infant mortality to be due to bad heredity, and thus to be an instance of natural selection, when, in fact, ante-natally acquired infection of syphilis was responsible. This grave error is involved in the biometrical publications on infant mortality throughout, and has long discouraged the efforts now being made, at last, to save the infants who are our national future.

C. W. SALEEBY.
Royal Institution, W., April 8.

Atmospheric Electricity.

IT would be interesting to know if any reader of NATURE has made observations similar to those made here on the afternoon of April 14.

A large thundercloud was just passing off in the east without having produced any obvious thunderstorm phenomena. The sky overhead was occupied by cirrus, while a second thundercloud was coming up in the west. It was found that sparks, one of them certainly reaching 2 or 3 mm. length, could be drawn from the metal of a Besson comb nephoscope, supported on a wooden stand, with the comb at a height of $3\frac{1}{2}$ metres above an asphalt roof (itself 12 metres above ground), on which observer and nephoscope stood. The leaden roof of a wooden cistern casing yielded similar results, but the most surprising observation was that a Campbell-Stokes sunshine recorder, bolted and cemented to a concrete parapet extending about a metre above the asphalt, also gave

quite appreciable sparks during the period of activity. The charges took fifteen or twenty seconds to build up after discharge, and the experiment was repeated very frequently.

The second thundercloud produced two peals of thunder and a slight shower, soon after which the abnormal electrical conditions ceased to manifest themselves, about three-quarters of an hour after they were first noticed. R. A. WATSON WATT.

Meteorological Office, South Farnborough, Hants, April 15.

The Influence of Tides on Wells.

REFERRING to Mr. Jas. Kewley's letter in NATURE of April 13, it is not unusual for the water in wells to rise and fall with the tides when such wells are near the sea. But is it necessary to assume that the phenomenon is due to the weight of the incoming tide compressing the underlying strata, as suggested by Mr. Kewley? Surely it may be sufficiently explained on the assumption that as the rising tide is a rising head of water it, without necessarily compressing the rocks beneath, tends to compress the air and replace the less dense fresh water included in the interstices and fissures, thus affecting the water-level of any contiguous well. In this connection may I direct attention to a letter of mine on "Tidal Action of the Earth's Crust," published in the *English Mechanic*, June 11, 1909? CECIL CARUS-WILSON.

PHYSIOLOGY IN THE WORKSHOP.

IN the never-ending struggle between capital and labour, or rather between employers and workmen, the points of dispute have been largely concerned with the hours of labour and wages, the employers trying to obtain as long hours for as low wages as possible, while labour has struck for a shortening of hours with increased wages. Labour is thus regarded as a commodity, to be bought as cheaply and sold as dearly as possible.

In most of these disputes it would seem that both sides have lost sight of the fundamental conditions of their own prosperity. It is, after all, of little account to the employer that he should be able to buy cheaply so many hours of other men's lives. The only factor which really concerns him is that he should be able to produce as large a quantity of his goods as possible at as small a price as possible, reckoning both rent of capital and cost of labour. An implicit assumption seems always to be made that the more hours of a man's life the employer can buy for a certain sum, the cheaper will be his cost of production. But labour also is concerned in the cost of output. It is a truism that when business is slack, *i.e.* when the profits are small, strikes are few and far between, the workers recognising that it would be better in many cases to close down works than to give them increased wages. Both employers and workmen are therefore concerned that the industry in which they are engaged should be as prosperous as possible, *i.e.* that production should be as cheap and rapid as possible. To this end both parties should co-operate. The only divergence of view which is reasonable should occur later when the question arises of the division of the profits, *i.e.* as to how much should be assigned to labour and how much fo management and rent of capital.'

Both sides are therefore interested in th efficiency of labour and its use to the best possibl advantage—the employer in order that he ma obtain as great a production at as small a pric as possible; the workman that he may be abl to earn enough to keep himself in comfort, whil allowing some time in the day or week for recrea tion and the enjoyment of life.

It is remarkable how little attention has bee paid in this country to the problem of how t use labour to the best possible advantage. Th appearance of a Memorandum on "Industria Fatigue and its Causes" (Cd. 8213, Wyman an Sons, Ltd., price 1½*d.*), which has been draw up and issued by the Health of Munition Worker Committee, is therefore of extreme importance a the present time, since its object is to point ou the only method by which increased efficiency o production can be attained.

In this pamphlet it is shown that the problen of scientific industrial management is funda mentally a problem in industrial fatigue. Fo the continued efficiency of an animal or man, res must alternate with work, and the periods of res and work must vary with the type of work in volved. This elementary principle is acted upo generally in our management of horses. Th report is a plea for its application also to th case of man. We cannot get the utmost possibl work out of man or horse unless this principle taken into account. We have thus to determir in the case of man what are the maximal efficienc rhythms for various types of work and worker For work in which severe muscular effort required it seems probable that the maximal ou put over a day's work and the best conditio for the workers' comfort and maintained heal will be secured by giving short spells of strenuo activity broken by longer spells of rest, the rel tive amount of time devoted to resting bei greater than in employments in which nervo activity is more prominent or more complicated

The truth of this statement is well illustrat by an anecdote recorded in the Memorandu before us. Two officers at the front competed making equal lengths of a certain trench ea with an equal squad of men. One allowed h men to work as they pleased but as hard as po sible. The other divided his men into three s to work in rotation, each set digging their hard for five minutes only, and then resting for until their turn came to dig again. The lat team won easily. Another instance is that o munitions factory, where men engaged in severe work of moulding were required to r fifteen minutes in every hour of work. The m objected to this long spell of rest in each h because the work was piecework, so that manager had to make the hourly rest compuls and appoint a foreman to see that the regulat was complied with. As a result of this the out per hour was found to be actually increased.

It is evident that the optimum working rhythm for each kind of work can only be determined

observation and experiment, and it is pointed out that since the true sign of fatigue is diminished capacity, the measurement of output gives the most direct test of fatigue, and thereby also serves as a criterion of success in devising conditions of work which shall avoid fatigue.

No works manager should consider that the conditions of work are satisfactory in his factory or department simply because these conditions have been observed for many years. Progress can only be attained by the constant maintaining of an experimental attitude of mind and the actual institution of experiments in the conditions of work themselves. Such measurements of output should be recorded for groups of workers as well as for the individual worker. Information on individual output is often valuable. It may reveal the adoption by certain individuals of particular habits of manipulation which tend to avoid fatigue, and may then be taught to the other workers. Moreover, these tests of individual capacity give an opportunity of rearrangement of workers and their assignment to jobs for which they are particularly fitted. It is mentioned that astonishing results, bringing advantage both to employers and employed, have been gained in other countries by the careful selection of individuals for particular tasks, based not upon the impressions of foremen, but upon the results of experiment.

We gather from the report as a whole that in nearly all cases the hours of labour have been too long. This is especially marked in the stress brought about by the present war. This undue lengthening of hours causes not an increase, but a diminution of output, and gives rise to staleness and a state of lethargy and indifference often accompanied by a craving for change and excitement, for which in some cases alleviation may be sought in the undue use of alcohol.

The Committee points out the necessity for a co-operation of the workers with the management in experiments to determine the optimum relations of spells or shifts of work to rest intervals and to holidays. They remark that it is not surprising that a tradition of slowed labour has arisen among workers as a kind of physiological self-protection against the excessive hours of work which have been imposed upon them—hours which are in excess of those suitable for maximal efficiency. This tradition of slacking will make a real difficulty in the endeavour to improve the workers' conditions while maintaining or increasing output. Thus it is mentioned that in one factory, a shop staffed entirely by new hands after six months produced 13,000 articles per week as against the 5,000 for which the sheds were designed. This output was not approached by the older hands in the other shops. Apparently it is not easy to change a customary rhythm of work which has been imposed automatically as a method of unconscious self-preservation.

In view of the necessity for periods of rest, it is not surprising to find that the Committee unreservedly condemn the practice of working without a Sunday rest, or, at any rate, one day's rest in the seven. They quote one foreman to the effect that Sunday work gave "six days' output for seven days' work on eight days' pay." Here again the Sunday was a period of slacking, necessary for the continued work of the men, but a pure waste of time so far as the management was concerned.

It is impossible in this notice to give an adequate account of the sound reasoning contained in this Memorandum. We may only hope that it will be read and digested by employers and labour leaders alike. Only by their co-operation along scientific lines can we expect to hold our own and rebuild our financial position in the acute commercial and industrial struggle that will follow this great war. E. H. S.

THE SHORTAGE OF DYESTUFFS.[1]

THE Society of Chemical Industry has recently issued a reprint of five papers read before its New York Section on the manner in which the United States is dealing with the shortage of dyestuffs. These papers are of particular interest in view of the general similarity presented by the industrial problem in Great Britain and in the States. In both countries the legal profession "governs," in both the scientific "expert" finds an easy prey in a wealthy but uninformed investing public, and in both industrial development is heavily taxed by parasitic professions which add nothing to the national store of wealth, knowledge, and productiveness.

Under these conditions the United States, like Great Britain, has become largely dependent upon Germany for her supplies of fine chemicals, and the reprint under consideration indicates that much the same remedies for this pathological condition are suggested in both countries. Dr. E. E. Pratt tells again the well-known tale of the sale of European aniline under cost price in America for the purpose of killing the Benzol Products Company, and several writers refer to the possible danger of "dumping" after the war and to the necessity of legislative prevention of this operation. Dr. T. H. Norton, whilst indicating the determination of American industrials to build up a native manufacture of coal-tar products without prolonged discussion of tariff issues, is perhaps weak in suggesting that useful assistance may be obtained from the Swiss firms; America is surely possessed of so much natural talent and self-reliance as will suffice for the establishment of a national industry without foreign help. Dr. Norton, however, makes one suggestion which seems novel, and which we should do well to act upon, not so much in the interests of the colour manufacturer as in those of the dyer and consumer; he proposes that the degree of purity and the methods of use of dyestuffs should be standardised by a central bureau. Such a control upon the purity of colours, and also upon modes of application to the various fibres and fabrics, would tend towards economy, would assist in diminishing the unnecessarily large

[1] The Dyestuff Situation in the United States. Journal of the Society of Chemical Industry, December 15, 1915 (No. 23, vol. xxxiv.).

numbers of dyestuffs used, and would hamper the operations of vendors of proprietary, and often comparatively valueless, colour mixtures now offered to the dyer.

Curiously enough, two important topics seem almost to have escaped discussion in the present reprint; very little is said as to how the new American industry is to advance, and as to the way in which a supply of technically-trained chemists is to be obtained. Perhaps it is premature to expect any comprehensive scheme which leads into the unknown future of chemical technical development at a time when the American textile industry is so grievously smitten by the sudden stoppage of dyestuff imports; it is, however, to be noted that the establishment of a coal-tar industry must, to be successful, carry with it the development of many congruent manufactures relating to medicine, photography, and other arts and sciences dependent upon organic chemistry. The other point, as to the provision of technically-trained organic chemists, was merely mentioned by Dr. T. M. Bogert, and with the statement that assistance is required in the shape of grants to universities and colleges.

This latter is a question which has been frequently considered and discussed with us. British Governments and municipalities have expended vast sums for the purpose of aiding the technical industries; whether the expenditure has been justified by the results is extremely doubtful. When any body of teachers, keenly interested and highly competent in its work, feels its activities cramped by lack of funds, and formulates a practical scheme for useful development, it has perforce to pass the scheme on to some higher authority less acquainted with the subject at issue but nearer the source of means. This latter body hands the matter with appropriate explanations to still higher, and ever less learned, authorities until the real, but sublimely ignorant, fountain head is reached and authorises the expenditure of money under conditions which do not necessarily make for efficiency. The required grant is obtained, not by the convincing force of argument, but by the melting power of cajolery. Manufacturers who require technical assistance, and the colleges and universities which are prepared to train the men, must surely learn to rely upon their own efforts rather than upon possible money grants extracted from non-academic governing bodies. Money is undoubtedly required to assist our educational institutions to turn out large numbers of men capable of useful work in the development of our technical industries, but it is questionable whether the present recognised methods for obtaining and using the money are efficient.

In this connection it may be recalled that Dr. W. H. Perkin, the professor of chemistry in the University of Oxford, insisted in his presidential address to the Chemical Society last year upon the necessity for the presentation of a thesis on original research by candidates for an Honours degree in science in our universities. It may safely be asserted that the translation into practice of this view would do more for the development of the chemical industries in Great Britain than all the deputations which have been sent to Cabinet Ministers and all the discussions which have taken place on possible methods of stimulating chemical technology.

W. J. Pope.

THE PROPOSED BOARD OF AERONAUTICS.

Aeronautics has, somewhat suddenly, become a subject for public debate, and a serious request has been put forward for an Air Ministry to control the whole of the aeronautical supplies and hand over the products to the Army and Navy. It is perhaps a little unfortunate that the Zeppelin raids occupy so much of the discussion, for the military value of aeronautics in the present war is least evident in the case of the raids.

In order to appreciate the position, it is necessary to realise that the resources of aeronautical industry are not so great that all possible supplies can be obtained fully and quickly. Germany concentrated on rigid airships and obtained a supremacy in airships, whilst the Allies, and particularly Britain, placed their confidence in aeroplanes and gained a supremacy there, which, although not so absolute as that of Germany in airships, is of far greater military importance. Aeronautics is still very young, and is growing rapidly; anyone who, three years ago, had predicted the flight of many hundreds of aeroplanes for several hours of each day of the year would have been looked upon by the general observer as a dreamer. Is it surprising, therefore, that not a single belligerent foresaw what has happened? Without endorsing the claims that the Air Service will ultimately be more important than the Navy or Army, it does appear that the development of aeronautics has already reached a stage at which an Air Board must be contemplated.

Up to the present time the Navy and Army have had independent Air Departments, both of which have made use of private enterprise for the supply of aeroplanes. Experimental work on a large scale has been carried out, and detailed designs of machines proposed for manufacture in quantity have been produced by the Royal Aircraft Factory. The reproduction of machines to these designs has been largely the work of private constructors, who have also made machines to their own design, approved forms of which have been accepted into the Services. Both Air Departments have had the assistance of the Advisory Committee for Aeronautics, a scientific body controlling the aeronautical research at the National Physical Laboratory. A report on the work of this Committee was published annually until the outbreak of war. The organisation outlined above came into existence in 1909, and prepared the way for the extremely rapid growth of aviation in the last two or three years.

Recently a new Committee was formed under th

chairmanship of Lord Derby, the Committee being made up of members of the two Air Departments, the chairman, and Lord Montagu of Beaulieu. The Committee had no executive control in the sense lesired by the two non-Service members, both of whom decided to resign their positions. As Lord Montagu indicated a lack of co-operation between the members of the two Air Departments, the resignations produced a general feeling of depression, and to those most keenly interested in the future of aeronautics it has been a relief to find the work of some of the senior members of the Services recognised by promotion. Whatever may be said as to the existing conditions, it seems certain that the extraordinary progress of aeronautics during the war would in itself have been sufficient to raise the question of an Air Board; perhaps the formation of such a Board would facilitate reorganisation. The Government being he only body able to deal with the problem with sufficient knowledge as to facts, the Prime Minister's forthcoming statement will be awaited with considerable interest.

NOTES.

THE Royal Society has elected the following as oreign members:—Prince Boris Galitzin, of Petrorad, head of the Meteorological Service in Russia; Dr. C. L. A. Laveran, of Paris, discoverer (1880) of he parasite (*Laverania malariae*) the cause of malaial fever; Dr. Johan Hjort, director of Norwegian isheries; Prof. Jules Bordet, of the University of Brussels, eminent in bacteriology; and Prof. H. Kamerlingh Onnes, of the University of Leyden, the istinguished physicist who was responsible finally for he liquefaction of helium.

SIR RAY LANKESTER informs us that Prof. Metchikoff, of the Institut Pasteur, is recovering from his rious and prolonged attack of pulmonary inflammaon. He is not yet able to go into his laboratory, but able to occupy himself with some speculative inuiries. He would be glad to know of any wellcorded instances tending to show whether the pinion that men of genius are not usually the eldest rn in a family is well founded or not.

THE recommendations of the Royal Commission on Venereal Diseases were dealt with in an article in NATURE for April 6, and the opinion was expressed at the measures proposed by the Commissioners ust be approved of without hesitation. It is satisctory to be able to report that on April 14 Mr. Long, resident of the Local Government Board, received deputation from the National Council for Combating enereal Diseases, which presented a petition urging e importance of giving effect to the recommendations the Royal Commission. In his reply to the deputation, which was introduced by Lord Sydenham, r. Long said he had communicated with the easury, and it is prepared to provide the necessary ant to carry out the recommendations of the Comssion with regard to the provision of facilities for agnosis and treatment. These grants will cover 7 per cent. of the cost incurred by local authorities. is not proposed to create special hospitals for treatent of venereal diseases, since it is thought that atment will be carried out more efficiently at existg general hospitals.

A THIRD article on aircraft by M. Georges Prade pears in the *Times* of April 14, and deals with the "Armament of Aeroplanes." It is becoming more and more evident as the war proceeds that the most desirable form of fighting aeroplane is a compromise between the conflicting ideal forms for high speed and convenient gun position. It appears that the practicable weapons are the rifle, machine-gun, and pom-pom, and of these the machine-gun is most frequently used. The position chosen for fighting depends on the field of fire of the machine-gun, which may be fixed relative to the aeroplane, as in the Fokker, or variable, as in most aeroplanes. The machine-gun is commonly mounted so as to fire over the tail, or through a trapdoor in the flooring, and it is said that the shot which killed Pégoud was fired through a trap-door. Usually the German aeroplanes do not fire through the propeller, and, when attacking, endeavour to overtake and pass under the hostile aeroplane in order to get into a suitable firing position, but the flight manœuvres during a fight vary considerably from period to period. The Germans have succeeded in using a full belt of 250 cartridges in their machine-gun, but the Lewis gun used by British flyers is said to be the best for aeroplane attack and defence. The pom-poms, firing a small shell an inch or more in diameter, are not yet extensively used, as they call for a larger and more specially constructed aeroplane than that suitable for a machine-gun.

THE issue of the *Scientific American* for March 4 is an "industrial number," dealing largely with the need for the United States to be prepared for the industrial and economic problems which will arise with the declaration of peace. The editor of our contemporary is able to publish a letter upon this subject received by him from the President of the United States. Dr. Woodrow Wilson, writing from the White House, Washington, on February 11, says: "It will be a signal service to our country to arouse it to a knowledge of the great possibilities that are open to it in the markets of the world. The door of opportunity swings wide before us. Through it we may, if we will, enter into rich fields of endeavour and success. In order to do this we must show an effectiveness in industrial practice which measures up to our best standards. We must avail ourselves of all that science can tell us in aid of industry, and must use all that education can contribute to train the artisan in the principles and practice of his work. Our industries must be self-reliant and courageous because based upon certain knowledge of their task and because supported by the efforts of citizens in the mills. If scientific research and the educated worker go hand in hand with broad vision in finance and with that keen self-criticism which is the manufacturer's first duty to himself, the fields will be few indeed in which American commerce may not hold, if it chooses, a primary place."

AN Exchange Telegraph Company message from Paris, dated April 18, states that the Chamber has voted unanimously in favour of the proposal to effect daylight saving by altering the time by an hour, the object being to economise fuel and lighting.

THE council of the Royal College of Surgeons has awarded the Walker prize of 100*l*. to Mr. W. S. Handley, of the Middlesex Hospital Cancer Research Laboratory, for his work in advancing the knowledge of the pathology and treatment of cancer.

THE applications received for admission to Miss E. A. Browne's lecture on "Our Tropical Industries," at the Imperial Institute, on Wednesdays, have been so numerous that no further tickets for Wednesdays can be issued. It has, however, been decided to repeat the lectures on Thursdays in April, May, and

June, at 3 o'clock, commencing on April 27, and tickets for Thursdays may now be obtained at the Imperial Institute.

The annual meeting of the Marine Biological Association of the United Kingdom was held in the rooms of the Royal Society on April 12. Sir E. Ray Lankester was re-elected president, and Dr. A. E. Shipley chairman of council. The report of the council showed that a considerable amount of valuable research work was still in progress at the Plymouth Laboratory, notwithstanding the loss of staff and difficulties in collecting caused by the war. Experiments on the growth of scales of fishes under different temperature conditions are being carried on, and the regular study of the nannoplankton is continued. The laboratory continues to be used by a number of voluntary workers in addition to the members of the staff.

At the annual meeting of the Iron and Steel Institute, to be held on May 4 and 5, the following bye-law will be formally moved and voted upon:—"In the event of a state of war existing between the United Kingdom and any other country, or State, all members, honorary members, and honorary vice-presidents who shall be subjects of such enemy country, or State, shall forthwith cease to be members, honorary members, or honorary vice-presidents of the Institute, but they shall be eligible for re-election after the war in the usual manner." The acting president, Mr. Arthur Cooper, will induct into the chair the president-elect, Sir William Beardmore, Bart., and the Bessemer gold medal for 1916 will be presented to Mr. F. W. Harbord.

The death is announced of Mr. W. W. Cook, a biologist attached to the United States Department of Agriculture, and one of the leading American authorities on bird migration and distribution. In his collection of information on this subject he had especially utilised reports sent to him by lighthouse-keepers.

We regret to announce the death of Colonel A. E. Barker, professor of surgery at University College, London, and one of the most active and successful of British surgeons. He was in his sixty-sixth year, and died from inflammation of the lungs contracted while on active service abroad on April 8. Born and trained in Dublin, he was appointed assistant-surgeon to University College, London, in 1885, and became professor of surgery eight years later. In more recent years he applied himself with great success to improve the methods of obtaining anæsthesia by spinal injections, and did much to secure a safe means of administration. He improved the technique employed by surgeons in many operations, particularly in those involving operations on the abdomen and on joints. He was a fellow of the Royal College of Surgeons, England, and took an active share in the work of his adopted college and hospital.

The *British Medical Journal* gives particulars of the career of Sir Thomas B. Crosby, the first doctor of medicine to become Lord Mayor of London, who died at the age of eighty-six, on April 7. Sir Thomas studied at St. Thomas's Hospital, where he filled the appointments of house-surgeon and demonstrator of anatomy. He became F.R.C.S. Eng. in 1860, and two years later M.D. St. Andrews. He was elected Lord Mayor in 1911, being then in his eighty-second year, and it was noted that he was not only the first doctor of medicine but the oldest citizen to receive that office. He attended, as Lord Mayor, at the funeral of Lord Lister on February 16, 1912, at Westminster Abbey, following the pall-bearers in company with the Lord Provost of Edinburgh. He was at one time president of the Hunterian Society, before which he delivered, in 1871, the annual oration on "Modern Medicine"; he was also a member of the Senate of the University of London. He received several foreign Orders, including that of the Legion of Honour of France, of the Crown of Russia, St. Olaf of Norway, Danebrog of Denmark, and the Rising Sun of Japan.

By the death of M. Léon Labbé, full of honours and of years, France has lost one more of the Old Guard, the physicians and surgeons who were already in practice when Pasteur and Lister were young. It is just forty years since Labbé's "wonderful case," in 1876, of the successful removal of a fork from the stomach of a young man who had been playing tricks with that implement. The case got into the papers; Mr. Andrew Lang, in a delightful article in the *Daily News,* quoted Horace, "Naturam expellas furcâ," and observed that the surgeon, being unable to expel the fork by nature, had to call in the aid of its brother, the knife. But the point of the case is that it advanced the surgery of the stomach, especially the relief of patients with obstruction of the œsophagus by the introduction of food straight into the stomach through a narrow tube. For half a century Labbé practised and taught surgery in Paris, and his renown was great and well deserved. It was he, also, who in 1914 helped to bring about the law by which the protective treatment against typhoid fever is compulsory in the French Army. At the time of his death he was working hard in Paris for the French Army Medical Service. The honours of his profession came to him: he was president of the Société de Chirurgie in 1882; he was a member of the Académie de Médecine, and Commander of the Legion of Honour. He was a great French gentleman, handsome in face and in soul, and it seems a pity that he did not live to see France set free, and the dragon under her feet.

We record with regret the death, at Southsea, on March 30, of Dr. J. T. Leon, from cerebro-spinal meningitis, contracted from a military patient under his care. From an obituary notice in the *Lancet* we learn that Dr. Leon, who was fifty years of age, started his scientific career with the intention of being a chemist, and after leaving Clifton went to Germany. Later he entered at Unversity College, London, where he was Tufnell scholar in 1885. Two years afterward he graduated as B.Sc. Lond., and in 1890 was appointed assistant lecturer on physics and demonstrator of chemistry in St. Mary's Hospital Medical School. After holding those appointments for three years, he commenced his medical studies at St. Mary's, where he had a successful career, graduating as M.B. Lond. in 1896, and D.P.H. Camb. in the following year. After qualifying he was appointed on plague duty in India, where he did useful work in collaboration with Prof. Haffkine. He served throughout the South African War, and upon his return settled in practice at Southsea. On the outbreak of the present war he was mobilised as captain in the Royal Army Medical Corps (T.), and was appointed sanitary specialist officer for Portsmouth. His duties involved the inspection of the sanitation of the various camps in Hampshire, and the carrying out of the bacteriological work in connection with the various epidemics that arose. He worked assiduously at these posts, and there is no doubt that his death was due to his unsparing devotion to duty.

The announcement of the death of Mr. J. H. Collins, F.G.S., on April 12, at the age of seventy-five will be received with deep and sincere regret by a wide circle of friends, including nearly every person in Cornwall, where he was such a well-known ar

picturesque figure. He was a past president and honorary member of many learned and scientific societies, including the Institution of Mining and Metallurgy, of which he was also one of the founders; the Royal Geological Society of Cornwall; the Royal Cornwall Polytechnic Society; and the Royal Cornwall Institution. He was also an honorary member of the Imperial Mineralogical Society of Petrograd. For his scientific work he received the Henwood medal from the Royal Institution of Cornwall in 1893, and the Bolitho medal from the Royal Geological Society in Cornwall in 1898. He was the author of many very valuable works, all of which are regarded as classics on his special subject, including "Observations on the West of England Mining Regions," "The Hensbarrow Granite District," "Handbook of the Mineralogy of Cornwall and Devon," "Cornish Tin Stones and Tin Capels," "Origin and Development of Ore Deposits of the West of England," translation of M. Léon Moissenet's "Rich Parts of the Lodes of Cornwall," text-books on mineralogy for elementary and advanced students, and many others. He was chief chemist and metallurgist to the Rio Tinto Copper Mining Company for a period of more than twelve years, and latterly was chairman and managing director of the Wheal Kitty and Penhalls United Limited Tin Mines of Cornwall, and a director of the East Pool and Agar Mines, Ltd. For nearly half a century Mr. Collins devoted himself to a close study of the geology, mineralogy, chemistry, and metallurgy of the mines and mineral deposits of Cornwall; and it may be truly said that his knowledge of this special subject was unique. His death has left a gap in Cornwall which cannot easily be filled.

SOME years ago Prof. Richard A. J. Berry, of the University of Melbourne, rendered anthropologists a great service by publishing exact tracings of all the Tasmanian skulls he could find in Australian collections. In conjunction with Dr. A. W. D. Robertson he has now issued (Transactions of the Royal Society of Victora, vol. vi., 1914) an atlas of tracings of ninety crania of Australian aborigines. Each tracing is reproduced in natural size, three views being given of each skull. In a brief preface to this atlas of cranial tracings, we learn that the Commonwealth Government is awakening to the scientific value of the skeletal remains of its native races, and is to take steps to prevent the exportation of osteological material from Australia.

THE Journal of the Buteshire Natural History Society, vol. viii. (1914–15) is largely devoted to local antiquities. Dr. J. N. Marshall and Mr. J. Ritchie describe excavations at the fort and cave at Dunagoil, the peninsula at the southern end of the island of Bute. The cave, which was hollowed out by sea action, was obviously, like the fort, occupied in ancient times. The mammalian bones found included those of the wild cat (*Felis sylvestris*), the fox, wild boar, red and roe deer, the short-horned Celtic ox, and turbary sheep, the two last having been apparently domesticated. The animal remains as a whole would be sufficient to indicate that the cave-men belonged to a period not earlier than that of the predominantly round-headed Neolithic people. The absence of remains of the horse suggests that this animal, so common in Romano-British deposits, had not yet reached Bute, if indeed it had been introduced to Scotland at the time when the Dunagoil cave was inhabited. The most interesting remains of human occupation are bone and horn implements, stone pounders, and the spinning-whorl, while a piece of sheet bronze proves that after the disappearance of the earlier tenants the cave was occupied in the Bronze age. The report, which is well illustrated with plates of the discoveries, is a good example of the excellent work which can be done by a local society, the membership of which includes competent archæologists.

THE annual report of the Public Health Committee of the London County Council for 1914 has just been issued. It contains the reports of the county medical officer (Dr. Hamer) and school medical officer, and details of public health administration, main drainage, and housing of the working classes. The report is illustrated with a number of diagrams of statistical data. One of these shows the seasonal prevalence of body-vermin (bugs, fleas, and lice), and it is of interest that the seasonal prevalence of scarlet fever coincides with that of fleas. Whether this is merely a coincidence or no, further study alone can elucidate. The death-rate is slightly above that for 1913, and scarlet fever, diphtheria, typhoid fever, and erysipelas all show some increase of prevalence compared with preceding years. The marriage-rate attained the comparatively high level of 19·2, but the birth-rate again showed a diminution.

IN the *Psychological Review* (vol. xxiii., No. 2) Mr. J. B. Watson describes a means whereby a wide range of experiments can be performed on the conditioned reflex. The author claims that the method can be immediately applied to the study of many sensory problems, such as sensitivity to temperature and contact, fineness of localisation, differential sensitivity to pitch, etc., in animals, whether wild or domesticated, of any size, and in man also, and that the record is made in complete and permanent form by the animal itself. Students of animals, whether from the physiological or the psychological point of view, will find the article both interesting and suggestive.

THE growing interest in problems of psychology, and in particular in the experimental treatment of such problems, is plainly indicated by the appearance of the first number of the *Journal of Experimental Psychology*, published under the auspices of the *Psychological Review* Company. An interesting article, entitled "A Preliminary Study of Tonal Volume," will appeal to both physicists and physiologists. There has been much divergence of opinion as to whether extensity is really an attribute of tonal sensations or merely a question of association, low tones being associated to large instruments and to gross movements of the throat. As a result of a careful investigation G. J. Rich comes to the conclusion that if we accept independent variability as the criterion of an attribute, there is evidence for the differentiation of pitch and tonal extensity, judgments of tonal volume being made with as great consistency as is usual for attributive judgments.

SIR F. J. JACKSON describes, in the Journal of the East Africa and Uganda Natural History Society (vol v., No. 9), two nests of the African lung-fish (*Protopterus ethiopicus*). They were situated in a patch of coarse grass, were circular in shape, with a diameter of two and a half to three feet, and about eighteen inches in depth. But the most remarkable feature of these nests lay in the outer ring of mud, which was raised about an inch above the water-level and about five inches width. It had the appearance of being the work of a man rather than of a fish. The mud did not seem to have been pushed up from below, but rather to have been deposited from above, and then smoothed down, the surface being smooth and shiny. He suggests that this mud was brought to the surface in the mouths of the builders, and then beaten down by means of the flattened, slimy, eel-like tails.

MUCH attention has been paid in America to prevention of damage by frost to fruit and vegetable crops. The methods are based either on the prevention of low temperatures, or the protection of frosted plants from too rapid warming. The *Geographical Review* for February, 1916 (vol. i., No. 2), contains an illustrated article on the subject. Low temperatures are prevented by small fires, oil-pots (Fig. 1), steam pipes, or even by hot water in irrigation ditches. Apparently no method to utilise electrical energy has yet been devised. To reduce loss of heat by radiation, artificial clouds are caused by fires of wet straw, but lath screens are most effective, though too expensive as a rule. Mixing the air by some mechanical means to prevent ground frost on clear, calm nights would be useful, but no practicable method has been discovered. Rapid warming or "defrosting" is prevented by the same means used to check radiation, and also by spraying the plants with water at about 32° F. just before sunrise. This coats the plant with ice, which must be melted before warming can begin. As a result, warming is said to be gradual. All these, and other methods, are, of course, intimately associated with accurate weather forecasts, since the preventive measures are too elaborate and expensive to be employed unless required.

Photo. *F. E. Dean.*

FIG. 1.—Oil pots in operation in an orchard at Grand Junction, Colorado. The oil pots hold seven gallons each and burn crude oil in amounts depending on the heat required.

A SUMMARY of temperature, rainfall, and duration of bright sunshine in the United Kingdom for the first quarter of the current year, comprised in the thirteen weeks from January 2 to April 1, 1916, has been issued by the Meteorological Office. The mean temperature for the period was in excess of the average in all districts, except the south of Ireland, where it was normal; the greatest excess was 1·6° in the east of England. The absolute maximum temperature ranged from 53° in the north of Scotland to 65° in the east of Scotland, and the thermometer failed to touch 60° in several districts, including the south-east and south-west of England. Rainfall was in excess of the average in all districts over Great Britain, except the west of Scotland, and there was a deficiency of rain in Ireland. The greatest excess was 177 per cent. of the average in the east of England, while in the south-east of England the fall was 161 per cent. of the average, and 160 in the Midland counties. In the east of Scotland the rainfall was 141 per cent. of the average, while in the west of Scotland the fall was only 88 per cent. In the north and south of Ireland the fall was respectively 93 and 92 per cent. of the average. The rain-days were everywhere in excess of the normal, the number in the period ranging from 72 in the south of Ireland and 71 in the north of Scotland to 56 in the north-east of England and in the Midland counties. The duration of bright sunshine was generally deficient. The exceptional warmth of January and the heavy rains of February and March would considerably influence the quarter's results.

MR. P. W. STUART-MENTEATH has forwarded to us a group of pamphlets on the results of his long-continued investigations into the geological structure of the Pyrenees. They have appeared in the *Biarritz-Association*, and are entitled "Sur les Gisements Métallifères des Pyrénées Occidentales," because the interpretation of that structure greatly depends on the geological age of certain metalliferous (chiefly iron) deposits, in regard to which he differs widely from some members of the French Geological Survey. The question is too long and intricate to be dealt with in a short note, so that it must suffice to say that the map in one of the pamphlets, which represents his own views and recalls certain parts of the Alps, has a very reasonable aspect, and that he is opposed to a school of geologists in France who make greater demands on flat-folding and overthrusting than some who have studied that chain are willing to admit. His criticisms chiefly relate to the Survey map of the Mauléon Pyrenees, which is contradictory to his own observations; and these, as experience has taught him, are likely to be ignored, and if possible suppressed. He taxes its authors with misplacing sedimentary and intrusive rocks, confusing Cretaceous and Upper Palæozoic deposits, transforming typical Cenomanian and Trias into Silurian and Carboniferous, and transferring great slices of sedimentary strata from the southern to the northern side of the chain. If the charges which he brings against MM. Bertrand, Termier, and Carez be accepted, we must suppose that French geology is suffering from the incubus of official infallibility not less seriously than did British geology some five-and-thirty years ago.

ALTHOUGH in the last seven years there have been more than a dozen determinations of the constant of complete radiation, the results obtained have differed so widely that it has not been possible to fix on a definite value. Some of the differences may be accounted for by the radiators or the absorbing surfaces of the measuring instruments not being perfectly black, or by the neglect of the absorption of the radiation by the water vapour present in the air. Or it may be due to the form of measuring instrument adopted, and in this connection it is worth noting that when the radiation has been measured by a thermometric method, the result has in general been high, while the pyrheliometer has given mean results in fair accord with each other. In Scientific Paper No. 262 of the Bureau of Standards of Washington Mr. W. W. Coblentz reviews the work which has been done by his predecessors and recently by himself

on the subject and comes to the conclusion that the most probable value of the constant is 5.75×10^{-12} watt. cm.$^{-1}$ degree^{-4}.

THE composition of the exhaust from liquid-fuel engines has been studied by Mr. R. W. Fenning, who presented a paper on the subject to the Institution of Mechanical Engineers on March 17. Various fuels were employed, the considerations affecting their choice being volatility, purity, and general suitability for use as motor spirit; hexane and benzene were taken as standard, high-grade petrol and benzol as commercial fuels. Mixtures with air were exploded in a small glass vessel, and a complete chemical analysis was made of the products. Exhaust samples were also taken from an engine fitted with Dr. Watson's apparatus for measuring air and fuel, and these samples were analysed. In each case a set of curves was plotted, taking as abscissæ ratios of the fuel to air by weight, and as ordinates percentages of each of the products of combustion in turn. Such a set of curves is termed an exhaust-gas chart. The author concludes that with volatile fuels there is little difference in the composition of the products of combustion from air-fuel mixtures in a small explosion vessel or in an engine cylinder in spite of the conditions being so dissimilar. Another conclusion is that a very small quantity, if any, of unsaturated or saturated hydrocarbons is present in engine-exhaust gases; this statement is, of course, based upon the results obtained in gas analysis by the method adopted and described.

AN important paper by Dr. C. H. Desch, on "The Decay of Metals," is included in a recent issue of the Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. lix., part 5). Three chief types of decay are considered. The first is that due to allotropic change, of which the "tin pest," studied by Prof. Cohen, of Utrecht, is the most notable example; similar disintegration may, however, occur in certain light aluminium alloys, which are liable to fall to powder as a result of internal molecular change, though fortunately this does not occur with any of the alloys in common use. Disintegration may also occur as a result of internal strain set up by hard working. Thus drawn rods are in a state of severe tension in the outer layers, and in compression in the inner layers, whilst in rolled or hammered rod this distribution of stresses is reversed. The fracture of the strained metal may be accelerated by corroding agents, which in some cases cause it to crack with almost explosive violence, as when very hard-drawn rods of brass or bronze are touched with a solution of a mercury salt or of ferric chloride. Finally, metals may decay as a result of actual corrosion, as in the "graphitisation" of iron pipes, from which all the ferrite is removed, leaving a soft residue of cementite, phosphide, and graphite. All these different types of decay are illustrated by photographs, the excellence of which has become almost a commonplace feature in the work of the author.

MR. WM. SHACKLETON, assistant inspector of scientific supplies at the India Store depôt, writes to direct attention to the numerals designed by his predecessor, Col. A. Strange, F.R.S., in the early seventies. These are still used on surveying instruments of to-day. Mr. A. P. Trotter is a nephew of Col. Strange. He illustrated these numerals in the Journal of the Institution of Electrical Engineers for February 1, gave details of their dimensions, and used them as a basis for his attempt to design an improved set (see NATURE, February 24, p. 714, and April 6, p. 121).

OUR ASTRONOMICAL COLUMN.

COMET 1916*a* (NEUJMIN).—The following elliptic orbit has been derived by collaborators in the Berkeley Astronomical Department (Lick Observatory Bulletin, No. 280), from observations on February 29 (Yerkes), March 8 (Bamberg), and March 7 (Lick):—

T = March 11·2195 G.M.T. P = 5·186 years. $\mu = 684·14''$
$\omega = 193° \; 44·1'$. $e = 0·55465$.
$\Omega = 327° \; 38·8'$. (whence $\phi = 33° \; 41' \; 11·8''$.
$i = 10° \; 29·6'$. $\log a = 0·47658$).

The resulting ephemeris diverges in R.A. from that calculated at Copenhagen; thus interpolation for April 20 gives α 10h. 3m. 58s., and $\delta - 7° \; 38·0'$; the Copenhagen position being α 10h. 2m. 41s., and $\delta - 7° \; 34·0'$.

The comet was observed at the Hill Observatory, Sidmouth, on April 8. It was then very diffuse and faint, in approx. position at 9h. 27·1m. G.M.T., α = 9h. 39m. 51s., $\delta = -3° \; 54·9'$, very nearly midway in Right Ascension between the positions given by the two ephemerides.

SOLAR RADIATION.—Mr. R. S. Whipple's paper on instruments for the measurement of solar radiation, read before the Optical Society of London on March 11, contains an account of all the most important forms of instrument, from the Campbell sunshine recorder and the black bulb *in vacuo*, to the registering standard water flow pyrheliometer of the Smithsonian Institution. Of these instruments the Campbell sunshine recorder still holds its own as one of the most accurate means of measuring the duration of sunshine, while the black bulb *in vacuo*, the readings of which have been recorded so many million times by patient observers, is now thoroughly discredited. At the International Meteorological Congress in 1905 the Ångström pyrheliometer was adopted as the standard instrument for the measurement of the intensity of solar radiation. In this instrument one of two similar metal strips is heated by the radiation to be measured, the other by an electric current sent through it. Equality of heating is secured by two thermo-junctions behind the strips, the necessary heating current is read, and the rate of supply of energy calculated. According to the most trustworthy measurements made under conditions more favourable to accurate observation than our climate permits, the earth receives from the sun, on the average, 0·032 calories per square centimetre per second.

PROPER MOTION OF THE ORION NEBULA.—M. J. Comas Solà has obtained direct evidence that the annual proper motion of the great nebula is about 0·025″ by stereoscopic comparison of photographs. The near by small nebula, A.G.C. 1977, shows equal motion, but in the opposite direction, and it is considered to be in orbital relation with the first.

THE SYSTEM OF λ TAURI.—Prof. F. Schlesinger has found that λ Tauri most probably involves three main bodies, only one being bright enough to yield a spectrum (Publications, Allegheny Observatory, iii., 20). Partial eclipses at intervals of four days result from the revolution of a less massive satellite, whence also arises the chief oscillation of the spectrum lines, but a second more remote and smaller body betrays its existence and period of 34·6 days in a superposed secondary oscillation revealed by the residuals. The respective masses are largely conjectural; on certain assumptions they would be 2·5, 1·0, and 0·4 solar, and the distances from the centroid of the first two 3·2, 8·0, and 50·0 millions of kilometres. The great range of velocity (56·18 km.) found by Prof. Schlesinger, asso-

ciated as it is with a spectrum of early, though somewhat peculiar, type, has an important significance in relation to some of the suggested explanations of the tardy motions of isolated helium stars.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE spring meetings of the Institution of Naval Architects were held on April 12 and 13, at the Royal Society of Arts. The Marquis of Bristol's term of office as president has now expired, and he has been succeeded by the Earl of Durham. The institution scholarship has been awarded to Mr. T. S. D. Collins; a donation of 100*l.* has been made to the scholarship fund by the Earl of Durham; the annual gold medal has been awarded to Mr. A. W. Johns, and the premium to Mr. J. L. Kent, for papers read before the institution. The following members of the institution have been appointed to the Board of Trade Committee to consider the position of shipping and shipbuilding industries after the war:—Sir A. A. Booth (chairman), Sir Archibald Denny, Mr. W. S. Abell, and Mr. James Readhead. A presentation was made to the retiring president.

In the course of the Earl of Durham's address, he said that one paramount duty was before the whole nation—to prosecute the war until a satisfactory end was reached. Our naval architects had no better pride than to turn out everything destined for the Navy of the best possible quality. When the end of the war came he felt sure that the institution would be able to claim having done its share in the work.

Sir Philip Watts read a paper on the load lines of merchant ships, and the work of the Load Line Committee (1915). This paper consists largely of a historical summary, starting with the earliest recorded regulation, which appeared in Lloyd's Register book in 1774. The remainder of the paper gives the gist of the report of the Load Line Committee, presented in a form convenient for the purposes of the institution. Mr. W. S. Abell followed with a paper on some questions in connection with the work of the Load Line Committee. The question principally discussed is the formulation of a suitable standard of structural strength which might be adopted internationally for the necessary tests which it is desirable to lay down in order that the freeboard assigned shall not be so small as to bring undue strains upon the structure of a vessel. The rules of the registration societies have been developed from experience, and should form the basis of any analysis having for its object a general average of experience with ship structures at sea. The method adopted was to analyse the rules of the principal societies in terms of I/y, and the principal dimensions of the vessel with the view of obtaining a standard of longitudinal strength which would express rationally the minimum requirements found necessary from successful sea experience. In this way formulæ were found for the standard of longitudinal strength, the thickness of side plating, frame spacing, and the strength of hold frames. This paper is a valuable summary of some interesting work on the strength of ship structures.

Dr. C. H. Lees read a paper on the laws of skin friction of a fluid in stream line and in turbulent motion along a solid of great length. In this paper Dr. Lees shows how to reduce the problem of a very long body of rectangular or elliptic section towed along a wide tube filled with liquid, to the simpler problem of a long circular cylinder towed along the same wide tube, so long as the liquid moving past the body is in stream-line motion. Comparison of results calculated for the equivalent cylinder and Froude's boards shows very fair agreement for the last 34 ft. of the boards. The agreement is sufficiently close to show that there is in all probability an intimate connection between the frictional resistance of the after portion of a long towed body and that of water flowing through a pipe. It seems desirable that experiments should be made with the view of determining to what extent the propositions with regard to bodies of equivalent resistance in stream-line motion may be carried over to eddying motion, and, if it should prove they cannot be, to determine the corresponding propositions for eddying motion.

Mr. G. S. Baker contributed a paper on the skin friction resistance of ships, and our useful knowledge of the subject. The data for the friction of rough surfaces have been increased very considerably in the last few years. Most of the data are derived from model experiments, but in some cases authentic data for ships are available. One model of fine form, 16 ft. in length, tested in the National Tank, showed that plate edges increased the frictional resistance 3·7 per cent. The plates on the model represented 4-ft. strakes of $\frac{5}{8}$-in. plating on a 400-ft. ship. A plate, 20 ft. by 2 ft., tested in the Washington tank after immersion in Chesapeake Bay for two months (July and August, 1914) showed an increase in resistance over that of a smooth surface of about 50 per cent. The fouling and resistance went on increasing up to the month of December, when the resistance stood at about 220 per cent. increase over that for a smooth surface, and remained at that figure for some months. This suggests that a good time for cleaning and painting the bottoms of coasting ships, working at about this latitude, is October and November, as there is little growth in cold water for the next few months. Presumably there would be a period about May and June when the temperature had reached a point favourable for growth, when a new coat of paint would prevent the adhesion of growth to the surface.

In a paper on the subdivision of merchant vessels and the Reports of the Bulkhead Committee, 1912–15, Sir Archibald Denny suggests that, after the war is over, an interesting paper might be written dealing with the mass of information which will no doubt be available as to the behaviour of vessels damaged either sufficiently or insufficiently to sink them. It is interesting to know that many vessels have survived torpedo and mine attack, even when the damage was of a very extensive character. Thus the *Nigretia* struck a mine abaft the fore peak, and had a hole 40 ft. by 16 ft. blown in her, but she was saved by No. 2 bulkhead. The Germans also have not always realised the difficulty of sinking an oil-carrier, especially if she is running light—*vide* the *Artemis*. The tests made by the Bulkhead Committee on large tank bulkheads are described in a paper by Mr. J. Foster King. Drawings showing the deflection records and photographs of the bulkheads are included. In all, fourteen papers were read and discussed.

DANISH LABOUR ON BRITISH FARMS.

THE Board of Agriculture proposes to relieve the present shortage of labour on the farm by arranging for the introduction of agricultural workers from Denmark. In this connection attention may be directed to an exceptionally interesting article by Mr. J. Robertson Scott in the January number of the *Quarterly Review*.

The wonderful development of rural life in Denmark is largely due to the absence of coal and iron. Having practically no manufacturing industries, the Danes

have put their best brains and energies into the cause of agriculture, with the result that their system of rural economics is a model to the world. The high standard of agricultural education is chiefly responsible for this success; it is significant that 20,000 Danish farmers possess covered manure sheds, while 90,000 have water-tight liquid manure tanks. But in comparing this state of affairs with conditions on our farms at home, it must always be remembered that our system of land tenure does not favour similar development here. It is not only ignorance that still causes so much of the fertilising value of farmyard manure to be lost by careless storage. The Danish farmer, owning his holding, is able to borrow from his credit society the capital necessary for these improvements; the English tenant farmer is not in the same position. Many landlords cannot provide these aids to successful farming, even if they realise that it is to their ultimate advantage to do so.

It is, however, to the rural high school that we must look as the real source of Denmark's present agricultural prosperity. It may surprise many to learn that no merely utilitarian outlook dominates these schools. On the contrary, they endeavour to show the power of history, poetry, and science, and of a higher level of life and thought to glorify ordinary workaday existence. How will a man trained in an atmosphere of this kind fill the place of a typical agricultural labourer on our farms? If Danish workers are introduced in any numbers into English rural life the results cannot fail to be of great interest.

THE CULTIVATION OF SPONGES.

AN industry which promises a return of 3000 per cent. per annum on a very moderate capital expenditure is an attractive proposition. In the last issue of the *West Indian Bulletin* Mr. W. R. Dunlop describes the successful rearing of sponges from cuttings in the Caicos Islands, near Jamaica, and also the results of some earlier experiments in Florida. The sponges occurring naturally in West Indian waters have little commercial value, so that the material for planting must be imported. Although sponges are to a remarkable extent creatures of environment, and tend when transplanted to approach the native types in quality, there is evidence that this may not occur in selected localities in the Lesser Antilles. As the cuttings will only grow when attached to an anchorage, it is necessary to provide them with suitable means of support when planting out. Cement discs are used in Florida, to which the sponges are held by metal clips, but it has been found in the Caicos Islands that slabs of coral are quite as effective as the discs and naturally much cheaper. On soft or sandy bottoms a spindle is set in the disc to hold the cutting, otherwise the sinking of the disc tends to bury the sponge and kill it.

The crop is ripe for harvesting in from one to four years, according to the variety grown. To plant, harvest, and market one acre of sheep's-wool sponges costs about 4*l*. This is a large and valuable variety, taking four years to mature, and yielding 116*l*. per acre in the New York market. Assuming that one acre is planted each year, then, after four years, an annual expenditure of 4*l*. will yield an annual profit of 112*l*., if four acres only are under cultivation. No charge for management is included in this estimate. The growers in the Caicos find that the small reef sponges, in spite of their lower market value, give an even better return on capital than the wool sponges, because they mature in twelve or fourteen months. It will be surprising if this industry, apparently so profitable, needs much official encouragement.

NATIONAL ASPECTS OF CHEMISTRY.[1]

EXACTLY seventy-five years ago from March 30, 1916, the Chemical Society met for the first time at the Royal Society of Arts after a preliminary meeting on February 23, 1841, at which it was decided "that it is expedient that a Chemical Society be formed." Though the society has continued to hold its anniversary meetings on or about March 30, ever since then, under various conditions, no meeting except that in 1915 has ever been held in circumstances at all approaching those now prevailing throughout the entire globe. The Crimean and Boer Wars did not awaken in the nation any appreciation of the increasingly important *rôle* played by chemical science in warfare. On the other hand, the enormous possibilities for the destruction of human life afforded by the application of scientific methods to warfare had inclined people to the belief that such a war as the present, with its ruthless disregard of life, could never occur. Short of demonstration, chemists would never have believed that their science could have been prostituted as it has been by the enemy.

Many thoughts arise in our minds on such an occasion as the seventy-fifth anniversary of our society, leading us to reflect on the state of chemical science before 1841, on the aims and purposes for which it was deemed expedient to form such a society, and to examine the measure of success that has been achieved by the society in fulfilling the objects as laid down in the charter.

Reference was made to various letters received from the founders of the society, and to one in particular from Henry Fox Talbot, the well-known pioneer in photography, expressing the view that the science of chemistry alone was not sufficient to engage the attention of a society, and suggesting that electricity should be added. How erroneous was this view is shown by the fact that within a month or so of its formation the Pharmaceutical Society was founded, and of later years, amongst other societies which have sprung from the parent society, may be mentioned the Society of Public Analysts, the Institute of Chemistry, and the Society of Chemical Industry, each of which has its important functions to perform.

Looking back to the time of the "father of chemistry and brother of the Earl of Cork," who in his introduction to the "Sceptical Chymist" stated "that of late chymistry begins, as indeed it deserves, to be cultivated by learned men, who before despised it; and to be pretended to by many, who never cultivated it, that they may not be thought to be ignorant of it," one may indeed wonder, on perusing our Parliamentary and legal reports, how our legislators should be classed in accordance with this statement, and to doubt whether the attitude of so-called learned men towards chemistry had done more than "begin" to change during the last two centuries. The beginnings of this change and the initiation of the experimental method into true science by Robert Boyle and his contemporaries followed closely upon the Civil War. For a hundred years or so onwards from the time of Boyle, the gradual substitution of careful experimental work in place of speculation on the reasons for chemical and physical changes added greatly to our knowledge. The rise and development of the phlogistic theory and its final overthrow by Lavoisier illustrate this phase in the growth of our science. The vast strides made in the progress of chemistry date back to the time when the use of the chemical balance was insisted on by Black: by its use chemistry became an exact science. Black's modesty and his devotion to scientific inves-

[1] Abstract of the Presidential Address, entitled "Our Seventy-fifth Anniversary," delivered before the Chemical Society on April 6, by Dr. Alexander Scott, F.R.S.

tigation for its own sake often led to his claim to be considered as the founder of modern chemistry being overlooked.

The importance of chemistry to national existence was recognised in France as early as 1815, as is witnessed by the origin of the "Le Blanc Soda" process and the beet sugar industry in France. In our own country the electrolytic work of Davy and the discovery of benzene and of liquid chlorine by Faraday have formed the starting points of many of the manufactures of munitions and weapons of war now being employed, though more especially by the enemy.

Just as the Royal Society grew out of societies of a more informal nature, so the Chemical Society had as forerunners the Tepidarian Society, the Animal Chemical Society, and also a Chemical Society or Club to establish which an attempt was made in 1806.

From the very foundation of the society stress has been laid time and again, and by president after president, that it is upon the amount of research work carried out by its fellows that the reputation and true value of the society must depend. At the first anniversary meeting the council reported that it was "fully sensible that the utility of the society and its reputation in the scientific world will mainly depend on its publications." A curve was thrown on the screen showing the steady increase year by year in the number of original communications contributed to the Transactions, commencing at 42 (occupying 254 pp.) in 1841 and 1842, and reaching 272 (occupying 2909 pp.) in 1914. In 1905 the first volume of the annual reports on the progress of chemistry, initiated by Sir William Tilden, was published.

The president then dealt briefly with the progress made year by year by the society, referring more particularly to the jubilee of the society in 1891, and to the jubilee (in 1906) of the discovery of mauve. In 1876 a proposal to establish a research fund was revived, when Dr. G. D. Longstaff promised to give a sum of 1000*l.* if an equal amount were subscribed by chemists. With a like sum from the Goldsmiths' Company, together with donations from the Merchant Taylors' Company, the Mercers' Company, and the Clothworkers' Company, the research fund was placed on a sure foundation.

Reference was made to the importance of stimulating and encouraging research if we, as a nation, are to hold our own in commerce and manufacture. That it is the duty of everyone to do his utmost to wrest from nature her secrets is tacitly agreed to by all, but, unfortunately, there the matter rests. The apathy of the public to the vital importance of research is due in great measure to the fact that the so-called well-educated classes have no conception of what research means. The classical scholar pure and simple adds but little to the sum of human knowledge. He examines the knowledge accumulated in past ages, extracts what is buried there, much as a ploughman on the battlefield of Waterloo looks for a bullet fired a hundred years ago. He wonders by whom the bullet was fired, whom it hit, and other such matters, which, however interesting they may be, are of little use to anyone. The classic may retort by demanding of what use are many of our chemical researches? Let us look, therefore, at what research has done.

Research may be divided into two categories: (1) the mere addition of fresh knowledge to that already recorded: of fresh mastery over the powers of nature and of new ways of utilising energy; and (2) the definite quest for the solution of a particular problem, it may be the manufacture of something occurring in nature or of something which shall have definite properties. The experiments of Cavendish on the composition of the atmosphere when he converted nitrogen and oxygen into nitric acid are typical of the first class of research. From this discovery an industry of vast importance to the world, the utilisation of atmospheric nitrogen, has sprung up in Norway, America, and Switzerland. Moissan's researches into the reactions at temperatures producible by means of the electric arc led to the production of many new compounds, including calcium carbide. These two industries have been established as the result of experiments made solely to increase our knowledge. Who could have foreseen what the discovery by Faraday of benzene in oil-gas would lead to at no distant date?

As examples of the second type of research may be mentioned the researches which led to the synthesis on a manufacturing scale of alizarin and of indigo, and to those which led Ehrlich to the discovery of salvarsan.

Broadly, there are two types of chemists who enlarge our knowledge: the one who feels that he can best fulfil his life's purpose by devoting himself to the discovery of new laws and new substances for the simple purpose of increasing the store of general knowledge so that those who follow after may reap the benefit of his labours. For such a man the reward is too often only the joy of having succeeded in his aim, well knowing that the money prizes attached to the application of his discoveries to industry will not be his. The other type is the man of practical bent who is always striving to apply the knowledge of the laws of nature and of the properties of substances to the solution of definite problems which confront the chemical manufacturer, the engineer, and others. Both types of men must be trained in the most thorough manner possible in the universities, and be taught how to tackle both theoretical and practical problems in a scientific manner.

The manufacturer is prone to expect his research chemist to indicate almost immediately the value of his presence in the works by a visible increase being shown in the profits. It is by no means a rare thing for a chemist employed at a miserable salary to be consulted in the same way as a specialist who is called in to see the patient on his death-bed. Had the aid of the chemist been sought earlier he, like the specialist, might have been successful in achieving the desired object. If the chemical manufacturers are not only to hold their own, but are to save themselves from extinction, there is only one remedy: they must seek the services of the man with a broad and sound foundation of the facts and theories of the day, and with a thorough training in the methods of advancing knowledge. Merely to maintain the dead-level of a fair measure of success is an existence which can only satisfy a decadent race, and this war has shown the British race to be as full of energy, bravery, and chivalry as of old.

The nation is now learning day by day what neglect of science has meant to it, and our legislators are having the importance of science forced upon them. Perhaps no branch of scientific knowledge has been more appreciated for the time being than chemistry, though it has required hundreds of thousands of tons of T.N.T., lyddite, and dynamite to shade the foundations of their ignorance.

The newspapers and scientific journals have laid bare the defects of our education, more especially with reference to our scientific education. It is obvious that if the manufacturer is to employ properly trained chemists, he must be provided with an adequate supply not only of men trained in what are known phenomena, who may be mere walking encyclopædias, but of men who are trained to attack problems.

There are, however, many points which our newspaper correspondents overlook when casting blame on the various educational authorities for their shortcomings. Much difficulty was experienced by head-

masters in obtaining men who could teach and keep order in a class. Often the man who taught science in school did so as junior mathematical master because his other teaching duties were lighter than those of his colleagues; but his knowledge of the subject might be but little deeper than that of the scholars he was instructing.

Where schools have been fortunate enough to secure properly trained science masters, the masters have usually to prove their value to the school, not by sound, all-round teaching, but by devoting much time to coaching-up the brilliant boys to win scholarships. Owing to the absurd nature of many of the questions set at the open scholarship examinations, candidates are forced to read and "get-up" quite specialised branches of work of far too advanced a nature, instead of devoting themselves to acquiring a sound knowledge of the principles and experimental data and their relations to the fundamental principles of science. Again, the successful scholar, say, in chemistry, is usually too proud of his position to go to a course of lectures on general chemistry by the professor, but prefers to attend special courses on advanced subjects, and thus become a specialist long before he should, suitable, perhaps, to hold a fellowship of his college, but almost as unfitted as his fellow-classic for active and useful life in an industrial centre and for facing industrial problems.

The brilliant youth who goes to Oxford or Cambridge, and whose ambition it is to lead the life of a student, is taught to regard the fellowship of his college as the greatest prize at which he can aim. Although the college authorities may state that the chances of gaining a fellowship are open equally to a science and to a classical student, this is not the case, for the simple reason that the electors to fellowships are, in almost all colleges, mainly classical men, who, however fair-minded they may be, are unable to estimate the value of that which they do not understand. Again, in some cases, all the fellowships which a college may devote to natural science are given to one branch.

What are the prospects of a brilliant schoolboy who takes up chemistry as his subject, and, after gaining a scholarship, obtains the highest possible places in the honours examination? If he be elected to a fellowship and decide to remain and take his part in the college life, his income as a fellow can only be regarded as a mere pittance if he is devoting himself to real research work. He may do fairly well at the Bar now that scientific opinion is more frequently sought in patent cases than it was; but no prize equal to the bishopric offered to members of the clerical profession can be his. There is no chance for him to hold any high Government office, for all the Civil Service examinations, whether at home or abroad, are heavily weighted in favour of the classical and mathematical candidate. Everything of a nature to test a man's ability to tackle an unknown problem, however simple its nature, is carefully excluded by cautiously worded syllabuses which detail the range of the facts and the nature of the tests which may be applied.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

We learn from the issue of *Science* for March 17 that in the will of the late Mr. R. R. Rhodes, of Cleveland, Western Reserve University, through its medical school and affiliated institutions, is a beneficiary to the amount of about 100,000*l.*; and that the will of Marie Antoinette Fisk, of Pasadena, Cal., gives 10,000*l.* to Princeton University.

Mr. Arthur Du Cros, M.P. for Hastings, has generously promised a gift of 7000*l.* to the Extension Fund of the London (Royal Free Hospital) School of Medicine for Women, thus completing the 30,000*l.* for which appeal was made. The appeal was first put forward in December, 1914, so that the sum has been subscribed in sixteen months. There have been more than twelve hundred subscribers, which is satisfactory as showing wide sympathy with the work of medical women. Next to Mr. Du Cros's generous gift, the largest subscription is 3000*l.* from Mrs. Garrett Anderson. The extension of the school is approaching completion, and will be opened in October next. It is indispensable to the increasing demands made upon the accommodation of the school, as another large entry of students is expected next session.

The annual report on the work of University College, London, which has now been published, deals with the period February, 1915–February, 1916, and includes financial statements for the session 1914–15. The total number of students who registered during the session 1914–15 was 1416, being a decrease of 790 compared with the preceding session. During the session 335 men students withdrew to join H.M. Forces, and forty-three other students to undertake some other recognised form of national service connected with the war. The total fees available for 1914–15 amounted to 18,936*l.*, a decrease of 9775*l.* on the prevous session. There has been a further decrease, both in the number of students and in fees received for the current session. The financial result in the course of two sessions is that the fee revenue has declined by some 24,000*l.* The position has been relieved by Treasury grants of 10,500*l.* for the sessions 1914–15 and 1915–16, and economies to the extent of about 9000*l.* will reduce the probable deficit at the end of the current session to 3500*l.* A very gratifying number of war honours obtained by members of the college are chronicled in the report. There are now sixty members of the academic and administrative staffs absent on war service.

The appointment of a Royal Commission on University Education in Wales is announced. The terms of reference of the Commission are as follows:—To inquire into the organisation and work of the University of Wales and its three constituent colleges, and into the relations of the University to those colleges and to other institutions in Wales providing education of a post-secondary nature, and to consider in what respects the present organisation of university education in Wales can be improved and what changes, if any, are desirable in the constitution, functions, and powers of the University and its three colleges. The following are the names of the persons appointed to serve on the Commission:—Lord Haldane (chairman); Prof. W. H. Bragg, Quain professor of physics, University of London; the Hon. W. N. Bruce, a principal assistant-secretary under the Board of Education; Sir Owen M. Edwards, chief inspector, Welsh Department, Board of Education; Dr. W. H. Hadow, principal of Armstrong College, Newcastle; Mr. A. D. Hall, a Commissioner under the Development Act; Sir Henry Jones, professor of moral philosophy, University of Glasgow; Sir William Osler, Bart., regius professor of medicine, University of Oxford; Miss Emily Penrose, principal of Somerville College, Oxford. The secretary to the Commission is Mr. A. H. Kidd, of the Board of Education, to whom all communications should be addressed.

The earnest appeal on behalf of the children which appeared in the *Times* of April 17 over the signatures of some of the most distinguished women of the

country demands the serious attention of the Government and the warm support of every true friend of the nation. In the stress of war it would seem that every reactionary influence finds its opportunity, with the result that the strenuous ameliorative efforts of past generations are to be brought to naught, and the fight on behalf of children must be re-fought once more. It is, however, satisfactory to find that some education authorities take a firm stand against the insistent demands of certain agricultural and industrial interests that children shall be released from school at an untimely age to labour in the fields and factories, and it is all-important that enlightened public opinion should support their action. Yet it is greatly to be deplored, having regard to the actual conditions of working-class life in industrial centres, that certain education authorities should, for reasons of so-called economy, seek to close the schools to children under five and to call upon the Government to raise the compulsory school age to six in order that children below that age shall likewise be excluded, with the result that the school life would be limited in certain areas to five years instead of nine. But perhaps the most unworthy demand is that of the managers of textile works in Lancashire, that the children in textile areas shall be compelled, during the war, to enter the factories. As the signatories well indicate, we owe it in reverence for the dead that we refuse no sacrifice in order to raise up a virile generation to justify their noble devotion.

SOCIETIES AND ACADEMIES.

LONDON.

Mineralogical Society, March 21.—W. Barlow, president, in the chair.—Dr. J. W. **Evans**: A new microscope accessory for use in the determination of the refractive indices of minerals. The accessory—a diaphragm with narrow slit adjustable in width—when placed in the primary focus of the objective or any point conjugate with it, serves several useful purposes. If placed parallel to the boundary between the two substances the refractive indices of which are to be compared by the Becke method, it gives better results than an iris diaphragm. In the case of doubly-refractive sections or grains in which an axis of optical symmetry lies at right angles to the microscope axis, the slit is placed parallel to the former axis, so that the paths of all the rays of light traversing it lie in a plane of optical symmetry and one direction of vibration is always parallel to the axis of optical symmetry, and a nicol is inserted so that the direction of vibration of the rays traversing it is parallel to the same axis; then the refractive indices of light vibrating parallel to that axis of optical symmetry may be investigated by the usual methods without the confusion caused by the bifocal images described by Sorby.—L. J. **Spencer**: A butterfly twin of gypsum. In a well-developed twin-crystal, 6 in. across, from Girgenti, Sicily, in which the twin-plane is *d*(101), the two individuals are situated on the same side of the twin-plane instead of on opposite sides as in the usual type.—Dr. W. R. **Jones**: The alteration of tourmaline. In a moist, tropical climate minerals which are ordinarily regarded as stable break down to an extraordinary degree. At Gunong Bakau, Federated Malay States, tourmaline is found more or less completely altered to a mica (probably phlogopite) and limonite, the degree of alteration decreasing with increasing depth from the surface, suggesting that the change was caused by the percolation of water from above. The freshness of tourmaline grains in sands is very probably due to the removal of the altered products by chemical and mechanical means.

Zoological Society, March 21.—Dr. S. F. Harmer, vice-president, in the chair.—Dr. T. **Goodey**: Observations on the cytology of Flagellates and Amœbæ obtained from old stored soil. This paper deals with the cytology and nuclear changes during division of three species of Flagellates and two species of Amœbæ obtained from soil stored in bottles at the Rothamsted Laboratory for practically fifty years. One of the Flagellates and the two Amœbæ are new to science.

Geological Society, March 22.—Dr. A. Harker, president, in the chair.—Prof. S. J. **Shand**: The pseudo-tachylyte of Parijs (Orange Free State) and its relation to "trap-shotten gneiss" and "flinty crush-rock." The rocks described as "pseudo-tachylyte" occur in irregular veins in the granite-gneiss of Parijs (O.F.S.). The author first regarded them as igneous intrusions; he now compares and contrasts these rocks with the "trap-shotten gneiss" of India and with "flinty crush-rocks" from Scotland, Argentina, and Namaqualand. The veins are irregular in form, dip, and strike; they freely branch and anastomose, and not uncommonly terminate blindly. The material consists of a dense black base, holding fragments of granite; these are sometimes so numerous that the base is reduced to the *rôle* of a mere cement between the rounded boulders. Microscopically, the rocks fall into three types, one of which is opaque and almost without individualised grains or crystals, while the others represent different stages of crystallisation of the first type. The production of the veins involved a temperature sufficient to melt the felspar of the granite, and there has been recrystallisation of felspar in the form of spherulites and microlites, and also of prisms of hornblende. In this evidence of high temperature, and in the absence of shearing phenomena in the granite, the pseudo-tachylyte of Parijs differs from all known crush-rocks and has affinities with pitchstones and tachylytes. Among the crush-rocks of Scotland, the author recognises a passage from the mylonitic type to a type in which fusion has been realised; the latter material is similar to the first of the Parijs types. A chemical analysis of the pseudo-tachylyte shows that the composition is that of a granodiorite, and is such as might correspond to an average of the variable dark gneiss in which the veins occur. It is suggested that a "melt" of granite, produced by mechanically-developed heat arising from the sudden rupture of the granite, would differ from a normal magma of granitic composition, and it is thought that the veins represent the solid equivalents of such a melt.

Physical Society, March 24.—Mr. F. E. Smith, vice-president, in the chair.—Mrs. C. H. **Griffiths**: A new method of determining ionic velocities. In the experiments described the kathode, which consists of a horizontal copper disc perforated with two holes, is mounted in a cylindrical glass tube open at the lower end. The whole is suspended from the beam of a balance, and is immersed in a vessel of copper sulphate. The anode is a copper spiral fixed in the electrolyte some distance below the mouth of the kathode vessel. From the rate of change of weight of the suspended system during the passage of a current the ionic velocities can be determined.—Dr. S. W. J. **Smith**: Note on an explanation of the migration of the ions. The object of this note is to show how a familiar diagram, appearing in many text-books, can be improved in a way which makes it easier to appreciate what happens at the electrodes in the simpler examples of Hittorf's method of determining the migration constant. An attempt is made to give precision to an idea which is sometimes vaguely expressed and frequently ignored.—Dr. S. W. J. **Smith**: A method of exhibiting the velocity of iodine ions in solution. Dilute solutions of potassium iodide and

potassium chloride of equimolecular concentration have almost the same electric conductivity. They are, therefore, of interest in connection with the direct measurement of ionic velocities. The paper describes a simple method of observing their common boundary. It is only necessary to add a little mercuric chloride to the potassium chloride solution. An extremely thin layer of mercuric iodide then forms where the two solutions meet. The method is particularly convenient for lecture purposes, and an approximate value of the ionic velocity can be obtained in a few minutes. The paper gives examples of the use of the method. The current is first passed in the direction which causes the iodine ions to travel towards the chloride. The chlorine liberated at the anode in this case supplies a means of re-determining the velocity of the ions when, the current being reversed, they move in the opposite direction.

EDINBURGH.

Royal Society, March 20.—Dr. J. Horne, president, in the chair.—Dr. C. **Davison**: The Ochil earthquakes of the years 1900–1914. The district chiefly affected lies on the south of the Ochil Hills, and includes Dunblane, Bridge of Allan, Menstrie, Alva, Tillicoultry, and neighbouring places. The earthquakes began in 1900, but did not become frequent until 1905, when ten shocks were felt. There were nineteen n 1906, thirteen in 1907, seventeen in 1908, eighteen n 1909, nineteen in 1910, eight in 1911, seventy-four n 1912, two in 1913, and one in 1914. The total number in the fifteen years was 186. The three earthquakes of September 21, 1905, October 20, 1908, and May 3, 1912, were of unusual strength, and were felt over areas of nearly a thousand square miles. The last of the three was so strong that a slight ncrease of intensity would have resulted in damage o property. The earthquakes seem to have been due o small movements along the great fault which skirts he southern slope of the Ochil Hills. There was vidence that the origins passed westwards as time progressed. There were indications both of an annual and of a semi-annual periodicity.—Dr. C. G. **Knott**: Mathematical note on the fall of small particles hrough liquid columns.—W. R. **Smellie**: *Apractoleidus Teretipes*. This Plesiaur was collected from the Oxford Clay by H. N. Leeds, and acquired for the Hunterian Museum by Prof. J. W. Gregory. The major portion of the skeleton is present, the bones eing in excellent preservation. In some respects the nimal is intermediate between *Cryptocleidus oxonensis* and *Tricleidus Seeleyi*; but in others it shows higher degree of organisation than either of these pecies. For example, in the fore paddle, the humerus esembles that of Cryptocleidus, except in the facets n the distal end; but it articulates with four elements s in Tricleidus. In this way it combines the advanges of both, and gives a broader and more efficient addle. The shoulder girdle is typically elasmourian, and the clavicles are reduced to thin, funconless plates, lying wholly on the visceral surface f the scapulæ. Both pectoral and pelvic girdles show ne animal to have been of great breadth. A high egree of ossification is a notable characteristic of ne skeleton.

DUBLIN.

Royal Dublin Society, March 28.—Prof. Hugh Ryan the chair.—Prof. W. **Brown**: The subsidence of rsional oscillations of nickel and iron wires when ubjected to the influence of transverse magnetic fields to 800 c.g.s. units. Experiments on the subsidence torsional oscillations of nickel and iron wires in ansverse magnetic fields, both direct and alternating, to a maximum of 800 units shows that the dampg of the oscillations is increased as compared with the oscillations with no field round the wire. When the frequency of the alternating transverse magnetic field is increased *eight* times, the damping of the torsional oscillations is *decreased* in nickel and *increased* in iron wire.—Prof. W. **Brown**: The change of length in nickel wire due to transverse magnetic fields, direct and alternating. The maximum expansion of nickel wire, due to transverse magnetic fields, both direct and alternating, takes place in a field of about fifty units, the longitudinal load on the wire being 2×10^5 grammes per sq. cm. For higher fields the expansion diminishes gradually, and for a transverse field of about 1000 units there appears to be neither expansion nor contraction.—Prof. Sydney **Young**: The boiling-points and critical temperatures of homologous compounds. The formulæ of Walker, Boggio-Lera, Ramage, Ferguson, and Young are compared, and it is shown that the author's formula gives the best agreement between the calculated and observed boiling-points of the normal paraffins, data for which, including some recently determined in America, are available from CH_4 to $C_{19}H_{40}$. The American chemists have also determined the critical temperatures of normal and *iso*-butane, and the rules regarding the deviations from Guldberg's law, T_c/T_b=constant, brought forward by the author in 1908 ("Stoicheiometry," p. 183), are found to hold good.

PARIS.

Academy of Sciences, April 3.—M. Camille Jordan in the chair.—G. **Bigourdan**: The discovery of the nebula of Orion by Peiresc. This discovery was for a long time attributed to Huyghens (1659), and later to Cysatus (1619). Proof is now given of the observation of this nebula by Peiresc (1610).—Pierre **Duhem**: The conditions which determine electrical movement in a system of several dielectrics.—M. de **Sparre**: The influence of atmospheric conditions on the trajectories of long-range projectiles. For the 40·6 cm. German gun, with a maximum range of 40 kilometres, it is calculated that an increase of temperature of 13° C. or a fall in the atmospheric pressure of 10 mm. causes an increase of range of 1792 metres.—Gaston **Julia**: The reduction of positive quaternary quadratic forms.—Henryk **Arctowski**: The variations of mean heliographic latitude of the sun-spots.—J. **Vallot**: The law which connects the calorific absorption of a cell with the refractive indices of the material of the cell and of the liquid which it contains. The method described in an earlier paper for determining the corrections due to the walls of the cell is applicable to most colourless liquids, but fails for highly viscous or coloured liquids. A method is outlined for dealing with these exceptional cases.—E. **Léger**: The isomeric acetyl derivatives of nataloin and homonataloin.—J. **Chifflot**: The sexual variations of the inflorescences and flowers in cultivated Codiæum.—Mlle. **Trouard-Riolle**: Cross between a wild crucifer and a cultivated crucifer with a tuberised root. The plants used in the experiments were *Raphanus Raphanistrum* and cultivated varieties of *Raphanus sativus*. The tuber formation on the wild plant was readily produced by crossing. The wild type tends to become preponderant in the descendants of the hybrid plants.—Jules **Wolff**: A substance coagulating inulin and accompanying it in plant tissues. This ferment was isolated from chicory roots and from dahlia tubers, and named inulo-coagulase.—Emile **Belot**: The possible origin of terrestrial magnetism.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (Saint-Genis-Laval) during the fourth quarter of 1915.—Marcel **Baudouin**: The early date of the jaw found at La Naulette. From a study of the two premolars the conclusion is drawn that *Homo Naulettensis* dates probably from the Pliocene epoch.—A. **Borissiak**: Indricotherium, a new genus of giant rhinoceros. The

largest representatives of this genus are of greater dimensions than the Mammoth.—E. **Bataillon**: Fecundation membrane and polyspermia in the Batrachians. —Charles **Nicolle** and Ludovic **Blaizot**: The preparation of an experimental antiexanthematic serum and its first applications to the treatment of typhus in man. It has been found that emulsions of the spleen or suprarenal capsules of the guinea-pig can be safely inoculated into horses, and repeated inoculations are possible. In this way the horse and ass have been rendered immune to typhus, and a serum has been prepared applicable to the treatment of the disease in man. Nineteen cases in men were treated and cured.

BOOKS RECEIVED.

Department of Marine and Fisheries. Meteorological Service of Canada. M.S. 51: Upper Air Investigation in Canada. Part i., Observations by Registering Balloons. Pp. 127. (Ottawa: Government Printing Bureau.)

Department of the Interior, Canada. Publications of the Dominion Observatory, Ottawa. Vol. iii., No. 2: Seismological Tables. By Dr. O. Klotz. (Ottawa: Government Printing Bureau.)

Exposition Internationale de Lyon, 1914. La Science à l'Exposition. By Prof. J. Mascart. Pp. 81. (Lyon: P. Legendre et Cie.)

University of California. Publications in American Archæology and Ethnology. Vol. ii., No. 6. Pp. 297–398: The Delineation of the Day-Signs in the Aztec Manuscripts. By T. T. Waterman. (Berkeley, Cal.: University of California Press.)

Journal of the College of Science, Imperial University of Tokyo. Vol. xxxv., Art. 7: Revision of the Japanese Termites. By S. Hozawa. Pp. 161+plates iv. Vol. xxxvi., Art. 7: Contributiones novæ ad Floram Bryophyton Japonicam. By S. Okamura. Pp. 51+tabula xxiv. Vol. xxxvii., Art. 2: Recherches sur les Spectres d'Absorption des ammine-complexes métalliques. I. By Y. Shibata. Pp. 28. (Tokyo: The University.)

Lezioni di Cosmografia: con 20 incisioni nel testo e due tavoli. By Prof. G. Boccardi. Pp. ix+233. (Milano: U. Hoepli.) Lire 3.

Gnomica: L'Orologia Solare a tempo vero nella sua moderna applicazione con 33 incisioni. By G. B. Barzizza. Pp. viii+199. (Milano: U. Hoepli.) Lire 2.50.

Manuring for Higher Crop Production. By Dr. E. J. Russell. Pp. 69. (Cambridge: At the University Press.) 3*s*. net.

The New Public Health. By Prof. H. W. Hill. Pp. x+206. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Cerebro-spinal Fever. By Dr. M. Foster and Dr. J. F. Gaskell. Pp. x+222. (Cambridge: At the University Press.) 12*s*. 6*d*. net.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. iv.: Fluorspar. By R. G. Carruthers, and others. Pp. iv+38. (London: H.M.S.O.; E. Stanford, Ltd.) 9*d*.

Quarantining Germany. By P. J. Ford. Pp. 16. (Glasgow: J. Maclehose and Sons.) 1*d*.

University of California. Publications in American Archæology and Ethnology. Vol. ii., No. 7. Pp. 399–472. The Mutsun Dialect of Costanoan based on the Vocabulary of de la Cuesta. By J. A. Mason. (Berkeley, Cal.: University of California Press.)

Institut de Paléontologie Humaine. Peintures et Gravures Murales des Cavernes Paléolithiques: La Pileta a Benaojan (Malaga) (Espagne). By l'Abbé H. Breuil, Dr. H. Obermaier, and Col. Willoughby Verner. Pp. 65+plates i–xxii. (Monaco: A. Chêne.)

A Manual on Explosives. By A. R. J. Ramsey and H. C. Weston. Pp. xi+116. (London: G. Routledge and Sons, Ltd.) 1*s*. net.

The Sense of Community. By Sir F. Younghusband. Pp. 25. (London: Williams and Norgate.) 1*s*. net.

A Veteran Naturalist: being the Life and Work of W. B. Tegetmeier. By E. W. Richardson. Pp. xxiv+232. (London: Witherby and Co.) 10*s*. net.

The South African Institute for Medical Research. No. 6: The Trypanosomes of Sleeping Sickness. By G. D. Maynard. Pp. 39+xxvi charts. (Johannesburg: W. E. Horton and Co., Ltd.) 5*s*.

Elementary Strength of Materials. By E. S. Andrews. Pp. viii+216. (London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

Spiritualism: a Historical and Critical Sketch. By the Rev. Canon E. McClure. Pp. viii+56. (London: S.P.C.K.) 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 27.

ROYAL SOCIETY OF ARTS, at 4.30.—Scientific Agriculture in India: J. MacKenna.

FRIDAY, APRIL 28.

GEOLOGICAL PHYSICS SOCIETY, at 5.—Presidential Address: Growths in Silica Gel: Prof. Benjamin Moore.

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THURSDAY, APRIL 27, 1916.

ANCIENT HINDU SCIENCE.

The Positive Sciences of the Ancient Hindus. By Dr. B. Seal. Pp. viii+295. (London: Longmans, Green and Co., 1915.) Price 12*s.* 6*d.* net.

A CHARACTERISTIC feature of the present-day literary activity of the philosophically ninded men of science in India is seen in the commentaries they are publishing from time to time n their ancient systems of scientific doctrine, artly, no doubt, with the object of enlightening Vestern nations concerning the existence in these ystems of certain root-ideas which are usually eld by us to be the product of Western thought lone. The more our knowledge grows the more ertainly will it be seen that many of these fundaiental concepts are common to all systems of hilosophy, and that, in the absence of an accurate hronology, it becomes increasingly difficult to etermine where or with whom their germs orinated. It is possible, of course, that some of ese fundamental ideas were independently coneived, but it is equally probable that they may ave had a common origin or have been radiated om a common source. In such case there is ound for the supposition that this common urce was India. But in reality it is impossible say with any approach to accuracy how Eastern owledge travelled in the far-off times to which e are referring. We can only surmise that these cient philosophies found their way along trade utes through Persia, Mesopotamia, Syria, to the eeks and Egyptians, and thence along the Meditranean littoral into Spain and western Europe.

In the book before us Dr. Brajendranath Seal kes no exaggerated claim to the antiquity of the dy of knowledge with which he deals. Indeed, says in the present state of Indian chronology is impossible to assign dates to the original urces from which his materials have been drawn. ictically, he thinks it may be assigned to the llennium 500 B.C. to 500 A.D., which is comparaiely late in the history of human thought. With pect to the West all he definitely asserts is that Hindus had, if not a prior claim, at least an ependent share with the Greeks in the work of structing scientific concepts and methods in the estigation of physical phenomena. Indeed, it is bable that they were earlier than the Greeks in umulating a body of knowledge capable of g applied to industrial technique. It is at least ain that Hindu scientific ideas deeply influenced course of natural philosophy in Asia—in China Japan towards the east and in the Saracen ire in the west.

he book under review consists of a series of ographs on the positive sciences of the ancient dus. Some portion of it has already appeared r. P. C. Rây's "Hindu Chemistry," viz., the pters dealing with the mechanical, physical, chemical theories of the ancient Hindus and wit their scientific methods. The author regards his book as preliminary to a more comprehensive work on comparative philosophy, since philosophy in its rise and development is necessarily governed by the body of positive knowledge preceding or accompanying it. Hindu philosophy, he considers, on its empirical side was dominated by concepts derived from physiology and philology, whereas Greek philosophy was dominated by geometrical concepts and methods. The ultimate object of his labours, apparently, is to attempt a comparative estimate of Greek and Hindu science, with, it is hoped, a measure of success and some approach to finality.

Dr. Rây's work on "Hindu Chemistry" has already been the subject of notice in these columns. On the present occasion, therefore, we purpose to restrict ourselves to an examination of the chapters dealing with Hindu ideas on kinetics and acoustics; on plants and plant-life; on the classification of animals; and on Hindu physiology and biology.

To begin with, a Western student of the book meets with an initial difficulty in the different systems of transliteration adopted by the two contributors. It is to be hoped, in the interests of uniformity, that if Western literature continues to be augmented by Eastern contributions of this character some understanding on this matter may be arrived at. It is difficult enough as it is for the Western mind to assimilate Eastern thought, or to appreciate its subtle *nuances,* without the difficulty being unreasonably increased by a matter which is surely capable of satisfactory settlement by philologists. A more serious difficulty consists in the employment by the author of terms like "isomeric," "polymeric," etc., which are essentially modern, and used by us in a perfectly definite sense to express modern ideas, but which in the book are adopted to connote conditions which are only very remotely analogous. Dr. Brajendranath Seal is well aware of what he admits is a questionable freedom. It would be difficult in all cases to suggest an alternative, but it must be admitted that the loose use of well-defined modern terms to express vague or only very distantly related ideas does not conduce to accurate thinking.

The chapter on mechanics deals with ancient Hindu ideas of the analysis of motion; of motion considered in relation to its causes; of motion not due to material contact of which the mechanical causes are unknown, and which are to be ascribed to the universal final cause (Adrista), *e.g.*, the first motion of primordial atoms, the upward motion of gaseous particles, the movement of iron towards the magnet, capillary motion as of liquid particles from the root to the stem of a plant, etc. The idea attached to the hypothesis of Adrista (which simply means "unseen") seems to have been modified in the course of time. Originally it would appear to have been used as an expression for agnosticism, no transcendental interpretation being attached to it. The chapter next treats of force; the causes of pressure, and of impact; gravity; curvilinear, vibratory, and rotatory motion; fluidity and the motion of fluids; measurement of motion; units of time and space; relative and serial motion. The author shows no inclina-

tion to see anticipations which are not strictly legitimate. He points out that the Vaiśeṣika theory of motion made only a distant approach to Newton's first law of motion, and that whilst a good foundation was laid for the explanation of the accelerated motion of falling bodies, Galileo's discovery was not anticipated. But there would seem reason to believe that Vâchaspati laid the foundations of solid geometry eight centuries before Descartes, and that Bhâskara (1150 A.D.), in computing planetary motion, appears to have used the differential calculus.

Ancient ideas on acoustics have a remarkable similarity to modern theories. It was recognised that the air was the physical basis of audible sound, and that its propagation was to be conceived on the analogy of waves in water. Various views, however, seem to have been held concerning the precise nature of the air-waves, as to the character of the vibratory movement, and how the molecules of a vibrating bell communicate their motion to the contiguous air-molecules. Echo was supposed to be a reflection of sound as an image in a mirror is a reflection of light. Attempts were made to explain pitch, intensity, and timbre by differences in the characteristics of the air-waves. The nature of musical sounds and intervals was the subject of acute speculation. Medieval compilations explain musical tones and their relations with reference to melody, as harmony was altogether unknown.

The wonderful plant-life of India naturally stimulated attempts at classification, and a short account of the various systems attributed to Charaka, Praśastapâda, Amara, and others is included in chapter iv. A section is devoted to elementary ideas of plant physiology, characteristics of plant-life, sexuality, and consciousness. It is a curious and suggestive chapter, not without interest to the modern plant-physiologist.

Not less interesting are the early Hindu attempts at the classification of animals based upon mode of origin—whether placental, oviparous, from moisture and heat, or from vegetable organisms. Snakes naturally received much attention, and elaborate accounts are given of the action of the poison of the several venomous families. This is one of the longest chapters in the book, and the accounts of the various systems are given in considerable detail.

Space precludes any attempt to give any description of ancient Hindu ideas concerning physiology and biology. Naturally, the phenomena of metabolism, of the circulatory system, and of the vascular and nervous system; of the seat of consciousness; of fœtal development; sex; heredity, received attention, and were the subject of speculation, often based upon acute and accurate observation, always interesting, and frequently highly suggestive. But enough has been stated to show that Dr. Brajendranath Seal has given us a most valuable contribution to the history of science by means of a work which must have involved a vast amount of study and research into a literature which is practically inaccessible to European students of physical science.

BRITISH FRESH-WATER RHIZOPODS.

The British Fresh-water Rhizopoda and Heliozo[a] By J. Cash and G. H. Wailes. Vol. ii[i] *Rhizopoda.* Part iii. By G. H. Wailes. P[p.] xxiv + 156 + plates xxxiii + lvii. (London: Ra[y] Society, 1915.) Price 12*s.* 6*d.* net.

To say that the volume before us equals, [if] it does not surpass, its predecessors, n[ot] only in scientific value but in general constru[c]tion, is to award it the highest praise. With th[e] completion of their task by the publication of th[e] concluding volume it will not be too much [to] state that what Leidy has done for the fresh[-]water Rhizopoda of North America the author[s] of this work will have done for the group i[n] Great Britain. Since the publication of th[e] second volume (in 1908) the senior author, Jame[s] Cash, has died, and a sympathetic biograph[y] forms a fitting introduction to this volume fro[m] the hand of Mr. John Hopkinson, who, as is we[ll] known, rendered him material assistance in th[e] preparation of vol. ii., and to whom the prese[nt] instalment is indebted for a series of synonymie[s] which may well serve as a pattern for all system[]atists, and may be said to constitute a practic[]ally complete bibliography of the subject.

The volume furnishes a very extended additio[n] to our knowledge of the distribution of thes[e] organisms in the British Isles, especially by th[e] incorporation of the splendid results of th[e] labours of Mr. G. H. Wailes (which were em[]bodied in his monograph of the group publishe[d] in the reports of the Clare Island Survey), wh[o] now joins Mr. Hopkinson as one of the autho[rs] of this book. By the addition to the British li[st] of Paulinella and Clypeolina, and the represent[a]tion of Gromia by Allogromia and Rhynch[o]gromia, the number of fresh-water Rhizopo[da] recorded as British is raised from forty-seven [to] fifty. The confused species *Euglypha alveola[ta]* is divided into *E. acanthophora* and *E. tuberc[u]lata,* a simplification which will be welcomed [by] students of the group, supported as it is by [a] remarkable synonymy comprising no fewer th[an] 157 well-considered references.

The authors direct attention to the speciali[sed] method of collecting reserve scales by *E. crista[ta],* and the contrivance by which the apex of the t[est] is closed in *E. mucronata.* The new classificat[ion] of the Gromiinæ will appeal as much to stude[nts] of the marine as of the fresh-water Rhizopo[da.] In this section the preoccupied name Pampha[gus] is replaced by Lecythium, as the outcome o[f a] laborious study of the existing synonymies. [W]e do not agree with Rhumbler (who is followed [by] the authors) that Dujardin failed to notice [the] anastomosing reticulations of the pseudopodia [of] *Gromia oviformis;* his four papers published [in] 1835 (Ann. Sci. Nat., 1835, "Infusoires," 18[] make the contrary view clear, but for taxonom[ic]al purposes Rhumbler's sub-family, Allogromia[inæ,] is undoubtedly useful. An interesting accoun[t] is given of the reproductive processes of *Mi[cro]gromia socialis,* as also of the indifferently ma[rine] or fresh-water genera, Lieberkuehnia and R[hyn]-

chogromia. The late J. D. Siddall was of the opinion that his remarkable genus, Shepheardella, shared this indifference to habitat, but did not publish his conclusions on the matter.

The twenty-five plates in colour and monotone are worthy of the best traditions of the Ray Society. Vol. iv., which will complete this admirable work, will consist of two parts: the first an addendum to vols. i. and ii., comprising species recorded as new to Britain since their publication; the second, dealing with the Heliozoa, will be the work of Messrs. Hopkinson and Wailes.

E. H.-A.

MATHEMATICAL TEXT-BOOKS.

(1) *The Essentials of Descriptive Geometry.* By Prof. F. G. Higbee. Pp. vi+204. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 7*s.* 9*d.* net.

(2) *Five-Figure Mathematical Tables.* Compiled by E. Chappell. Pp. xvi+320. (London: W. and R. Chambers, Ltd., 1915.) Price 5*s.* net.

(3) *Mortality Laws and Statistics.* By R. Henderson. Pp. v+111. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) 5*s.* 6*d.* net.

(4) *Arithmetic for Carpenters and Builders.* By Prof. R. B. Dale. Pp. ix+231. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s.* 6*d.* net.

(5) *Handy Logarithmic Tables.* By Y. Uraguchi. Pp. 7. (Tokyo: Y. Uraguchi, 1915.) Price 3*d.*

(1) THE author assumes on the part of the reader no previous knowledge of deriptive geometry, and only quite a superficial quaintance with ordinary plane geometry. The urse follows mainly the customary lines, includg points, lines, angles, planes, surfaces, and odel-making. There are three reasons why its neral character should commend itself to the dinary student. First, the diagrams are merous, clear, and unusually large; secondly, style of exposition is admirably lucid; and rdly, each chapter closes with a set of simple ercises; it would be a distinct improvement if swers were added, where possible.

(2) This book of five-figure tables includes arithms of number and their reciprocals, antiarithms (called illogs), logarithms of logams (called lologs), anti-"logarithms of logams" (called illologs), the trigonometric funcis and their logarithms, and a table of various stants. To lessen, in using the lolog tables, the nce of error which would occur from failure notice whether the logarithms are positive or ative, numbers less than unity are shown in and those greater than unity in black. This wise precaution. The book is well printed arranged in a convenient fashion.

(3) The author sets out in scientific form the lts of investigations into the duration of an life and the mathematical theory required t. The book is a treatise for actuaries or for hematicians interested in the theory of probability. The author has excluded the combination of life contingencies with the theory of compound interest, annuities, etc., and has confined himself strictly to life contingencies.

After opening with an historical account of the way in which mortality tables came to be compiled and improved, he proceeds to discuss the construction and graduation of tables now in use, and gives various modern tables in an appendix.

(4) This small text-book is admirably suited to meet the needs of the practical workman. It deals with the elements of arithmetic, but includes also a great deal of general and technical information, such as the use of tools, cost of material, economy of arrangement, and simple designs. The student who reads and works thoroughly through its pages will acquire a considerable store of valuable information: a worthy addition to an excellent series.

(5) These four-figure tables are printed on a thickish sheet of paper, 7 in. high, 31 in. long, folded into seven parts, and contain proportional parts, logarithms of number and their reciprocals, and anti-logarithms. We doubt whether they possess any advantage over the ordinary forms in use.

OUR BOOKSHELF.

The Mathematical Theory of Probabilities and its Application to Frequency Curves and Statistical Methods. By A. Fisher. Translated by W. Bonynge. Volume i. *Mathematical Probabilities and Homograde Statistics.* Pp. xx+171. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

It is remarkable that, in spite of the number of older works in English on the theory of probabilities and the great attention that has recently been devoted to statistical method, no modern work on the subject in our own language existed. Mr. Fisher's work will do much to fill this gap.

After an introduction on the general principles and the philosophical aspect of the subject, and a somewhat slight historical sketch, he develops the fundamental theorems of probabilities, the laws of mathematical expectation, probability *a posteriori* and Bayes's theorem, the law of large numbers, and the theory of dispersion. This theory is then applied to games of chance and to statistical problems. A second volume is promised on the theory of frequency curves.

The treatment is very lucid—the chapter on Bayes's theorem may be selected as a marked example—and the work will be of considerable service to the statistical student. It is to be regretted, however, that the author has not taken up some of the more difficult problems of statistical work and has stopped short at the elementary comparison of the actual dispersion of a series with the combinatorial dispersion.

There is no index, and it is to be hoped the promised second volume will supply one. In a future edition the spelling of proper names should receive attention.

Tuberculosis: A General Account of the Disease; Its Forms, Treatment, and Prevention. By Dr. A. J. Jex-Blake. Pp. viii+231. (London: G. Bell and Sons, Ltd., 1915.) Price 2*s.* 6*d.* net.

An excellent account of the subject of tuberculosis is given in this book, free from technicalities, so that it should be easily intelligible to those who possess no special education in medical or scientific matters.

The opening chapter deals briefly with the historical side of the subject, and then the tubercle bacillus is discussed. The different types of the bacillus are described—their occurrence and relationship to the disease in man—and a summary is given of the vexed question of the infection of man from bovine sources, in which both sides of the controversy are placed before the reader.

Predisposition and immunity, the paths of infection, and the statistics of tuberculosis are next dealt with, after which a general account is given of the disease as it attacks various parts of the body.

The subjects of prognosis and general treatment are discussed, and the book ends with descriptions of tuberculin and sanatorium treatment and suggestions for the prevention of the disease. The author throughout avoids extremes, and when there is a difference of opinion both aspects of the question are stated. The book contains a large amount of up-to-date information, and is a very useful summary; it should appeal to a wide public.

R. T. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The West Indian Firefly.

The writer is not in any sense an entomologist, but for this very reason his notes regarding this insect may have a certain interest as being from a different point of view from that usually taken. The beetle is much brighter than those with which we are familiar in the States and in England, and is always a source of interest to travellers. They first appear in Jamaica about the middle of February, and by the middle of June are found in great numbers, so that the fields as seen from a slight elevation sometimes appear strewn with wandering stars, much brighter than those in the heavens above. They are particularly numerous on damp or foggy evenings when there is no moon. Their light is constantly fluctuating, and the fluctuations occur more or less in unison over a considerable area, which makes their appearance much more striking. An individual light is readily seen at a distance of a quarter of a mile. They have powerful jaws, but nevertheless fall a ready prey to spiders, who consume them in large numbers.

The insect varies somewhat in size, but on the average measures 30 mm. (one and a fifth inches) in length, by 9 mm. in breadth, and is of a dark brown colour. Its system of lights is peculiar, and quite unlike the northern species. It carries a green light on either shoulder, and a much brighter orange light beneath the abdomen. This latter, however, is never shown except in flight, and at the very moment of leaving the ground. One often sees them flying along th side of a house, illuminating the eaves or clap-board ing with this bright orange light, much as a mar might do it with a dark lantern, evidently looking for food.

When attacked by a spider their light glows intensely and continuously under the influence of th poison. If crushed, the light continues to glow long after the creature is dead, but it can be shut off a will. If held in the hand while the light is turned on, the insect gives out a perceptible warmth, and on enclosing one in a wine-glass with a thermometer bulb, the mercury was found to rise 1° F. the first minute. It rose another degree the second minute and 0·6° in three minutes more. After this it slowly fell, although the light was still shining. Later, after the light had been extinguished, the thermometer returned to its original temperature, usually between 70° and 75°. Some fireflies are much more vigorous than others. With a weakly one the thermometer may not rise even as much as 1° in all. Two seem to be no more efficient in this respect than one.

The writer would like to have kept one a prisoner for twenty-four hours, weighing it at intervals, its loss of weight indicating the amount of its normal food consumption. Since its bulk, however, is but 0·7 of a cubic centimetre, its weight is abou 0·7 of a gram, and its food consumption would be so small that it would require a delicate chemical balanc to determine it with any accuracy. Such an instrument is not available here, so this investigation mus be left to someone else. Presumably, however, it eat about as much as other beetles of the same size.

On account of its only showing its brightest ligh when in flight, its candle-power is rather difficult t determine. This was accomplished indirectly, how ever. A great number of them fly along a neighbou ing road, and their position can be determined b their illumination of the enclosing stone walls. The brightness was found to equal that of the st Canopus, which was just over the road, and at rath a low altitude. Its brightness was at that time equ to α Orionis, the altitude of which was 40°. It w a very clear evening, as is generally the case here, that we may take the brightness of the latter as 1·0 magnitude. The distance of the road was 175 ft or 53 metres. A zero magnitude star is equal to o candle-power at 526 metres. If of zero magnitu the light of the firefly would therefore have been ju 0·01 of a candle-power. Being of first magnitude, i light was 0·004 c.p. This result is probably corre within half a magnitude, or 50 per cent., and co sidering the apparent brilliancy of the insect is small than one would have expected. The writer is n aware of any previous measures of this quantity.

William H. Pickering.

Harvard Astronomical Station, Mandeville, Jamaica, B.W.I., March 22.

"Optical Glass" and Fluorite: An Ethical Note.

Mr. F. J. Cheshire's letter in Nature of March recalls the most exceptional character of the publi tion by Prof. Abbe and the firm of Zeiss of that c covery of apochromatism for which all must still grateful. For the details I refer to the Journal the Royal Microscopical Society, ser. 2, vols. vi., v 1886–7. An article in vol. vi., p. 315f, "The N Objectives," is evidently based on the letter of P Abbe of March 4 (cited by Mr. Cheshire), for it c tains precisely the same window-dressing statem that optical glasses hitherto in use only contain chemical elements, while the new objective cont not fewer than fourteen. This article throughout c veys the impression that it has been alone the util

tion of new kinds of *glass* that has enabled Abbe to work out the conditions of practical apochromatism.

In the same volume, p. 848f, Zeiss's catalogue, "Neue Mikroskop-Objective und Okularen aus Specal-Gläzer des Glastenchnischen Laboratoriums" (Schott and Gen.), is reproduced "nearly *in extenso*." The same suggestion that only the new *glasses* are relied on is present throughout. Thus: "The objectives, however, like all productions of our firm, stand on an absolutely free basis. The glass employed is, by our own instrumentality, accessible to anyone, and no optician is in the least degree prevented from producing the same objectives as good and as cheap as he can." This is followed by extracts from the pamphlet by Abbe and Schott describing the new *glasses*, with their optical and other properties and prices. The abstractor seems by this time to have some suspicions as to whether scientific candour is not here empered with commercial reticence, for he goes on:—

"Suggestions are made as to the glass best suited or various purposes, and on commencing the perusal f these passages we had the idea that we were coming to a description of the *glass* used for the new bjectives. The following ingeniously worded paragraph, however, closes the subject.

"In the case of microscopic objectives which require for the attainment of the highest capacity of erformance not only agreement in the course of the ispersion of the crown and the flint, but also the orrection of the spherical aberration and its chromatic fference, it must be left to the skill of the practical ptician to choose the most suitable means from the bove series. The new objectives of Zeiss show what an be attained by their practical use."

We now pass to vol. vii., containing (p. 20f) a paper ad before the Royal Microscopical Society on October 13, 1886, entitled "On Improvements in the Microope with the Aid of *New Kinds of Optical Glass*." s contents fully justify the title; throughout the same ggestion is made that the *glasses* are alone responble for enabling the optician to attain the improveents connoted by the term apochromatism.

(I must state that the italics in the cited passages all mine.)

Three comments will close this somewhat long ter:—

1) Prof. Abbe, of Jena, was the brother-in-law of rl Zeiss, the "practical optician" of Jena.

2) It was soon discovered that one lens of fluorite fluorspar), the native fluoride of calcium, was an ential component of the apochromatic objective, as ll as certain of the new glasses.

3) Before the new lenses were placed on the market house of Zeiss had, as they believed, secured the ole supply of colourless, flawless fluorite, suitable optical purposes, which, like so many minerals, is ricted to few localities.

Marcus Hartog.

ork, April 6.

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rof. Hartog, in his "comments" Nos. 2 and 3, ves an old charge which was made by Mr. Lewis ght in the *English Mechanic* (1892), pp. 220–221. Lewis Wright, in speaking of the use of fluorspar he production of apochromatic objectives, there es:—

Though some of them have managed to secure a supply, others are painfully aware that before use of fluorite was allowed to become public all known available material had been secured by the of Zeiss at Jena; and the difficulty of getting rial experienced by some of our best makers is a idable obstacle to optical improvements and tends tificially keep up the prices."

is charge was replied to and repudiated by Dr. Czski, in a letter which appeared in the same volume of the *English Mechanic*, p. 287. Dr. Czapski in this letter states:—

"As regards fluorspar, Mr. Lewis Wright is labouring under a great delusion in assuming that before the use of fluorite was allowed to become public, all the known available material had been secured by the firm of Zeiss at Jena. The contrary may be said with more truth. The firm of Zeiss possessed but a very scanty supply at a time when, even previous to Mr. Koristka's groundless attacks in the *Journal de Micrographie*, the fact that fluorspar was being used in the apochromatic lenses had been published three times in consequence of information supplied by the firm of Zeiss.

"The latter were completely prepared to produce their future apochromatic lenses without having recourse to fluorspar, which by no means constitutes the condition *sine quâ non* for the production of apochromatic objectives, excepting, of course, in the case of such opticians who can only produce them by slavishly copying existing systems. As, however, the firm became eventually possessed of a considerable quantity of clear material, the employment of fluorite in their apochromatic lenses was continued."

The letters referred to above are reproduced in the Journal of the Royal Microscopical Society for 1892, pp. 552–555, from which the above quotations are taken.

I may be allowed to add that if Prof. Abbe and the firm of Carl Zeiss had wished to play the "dog-in-the-manger," they could easily have done so by taking out a patent for the application of the principle of apochromatic construction to microscope objectives. Prof. Abbe's "ethics," however, would not permit of this being done. He, I believe, held that since microscope objectives were practically entirely used for the purposes of scientific research, the taking out of a patent for them would have acted prejudicially to the best interests of science in general.

F. J. Cheshire.

The Remarkable Meteors of February 9, 1913.

The large meteors which passed over Northern America on February 9, 1913, presented some unique features. The length of their observed flight was about 2600 miles, and they must have been moving in paths concentric, or nearly concentric, with the earth's surface, so that they temporarily formed new terrestrial satellites. Their height was about 42 miles, and in the Journal of the R.A.S. of Canada there are 70 pages occupied with the observations and deductions made from them by Prof. C. A. Chant.

The meteors were last seen from the Bermuda Islands, according to the descriptions in the journal named (May–June, 1913).

I have since made efforts to obtain further observations from seafaring men through the medium of the *Nautical Magazine*, and have succeeded in procuring data which prove that the meteors were observed during a course of 5500 miles from about lat. 51° N., long. 107° W., to lat. $5\frac{1}{2}°$ S., long. $32\frac{1}{2}°$ W.

Mr. W. W. Waddell, first mate of the s.s. *Newlands*, writes me that at 12.13 p.m., February 9, 1913, he saw a brilliant stream of meteors passing from the N.W. to the S.E. during a period of six minutes. The ship was in lat. 3° 20′ S. and long. 32° 30′ W. at the time. He says the meteors disappeared in the region of Argo to the south, and I have assumed they were over about lat. $5\frac{1}{2}°$ S. and long. $32\frac{1}{2}°$ W. when he lost sight of them.

Such an extended trajectory is without parallel in this branch of astronomy. Further reports from navigators in the South Atlantic Ocean might show that the observed flight was even greater than 5500 miles.

W. F. Denning.

44 Egerton Road, Bristol.

FOREIGN WAR-PLANES.

An article with the above title appears in *La Nature* of March 4, and is particularly interesting at the present time when British aeronautics is attracting so much attention. The article appears to have been written in fear of the Censor, and parts of it correspond more nearly with the end of last summer than the early part of the present year. The author refers to the belief, prevalent in France some little time

Fig. 1.—The Morane Sauliner.

ago, that British aviation was well ahead of their own, a belief widely held until, during the course of a single day, French aviators and gunners brought down seven battle-planes and a Zeppelin.

Putting aside political manœuvres as of no importance, the author attempts to state the problems of aviation as they affect the engineer and constructor. Quite early in the course of his statement he concludes that the difficulties of flight would disappear, in peace-time, with the coming of a trustworthy light engine, but that for war purposes the problem is not so simple. A good war-plane must be strong and trustworthy; the observer must have a good field of view, particularly downwards, to assist reconnaissance and to make possible photography and bombing. In order to fight an enemy under favourable conditions, the zone of fire of the machine-gun must be as great as possible, and this implies a special shape of body. Finally, a convenient place must be found for bombs, and taken together the requirements are not easily satisfied.

As to speed, authorities differ, and there is again necessity for compromise, in this case between speed and weight-carrying. In France aeroplanes have mixed duties, whilst in England types differ more, are faster on the average than the French, but carry fewer bombs. The superiority of the Germans on speed is more apparent than real, their most recent and speedy aeroplane, the Fokker, being merely a copy of the Morane Sauliner. The similarity can be seen by a comparison of the two accompanying figures.

The similarity is said to be complete almost in detail, and immediately after the Morane had been fitted with a safety device for firing through the propeller, the Fokker followed suit.

German aeroplanes are built in three distinct classes. To the first belong the scouts, mostly Albatross biplanes, which have largely supplanted the Taubes; fitted with Mercedes motors of 100 to 150 horse-power, these aeroplanes fly at from 70 to 90 miles per hour.

The second group of aeroplanes, fighters, are designed for attack and defence in the air. A new biplane (probably that known to British soldiers as "Fritz" or "Billy-two-bodies") with two bodies and central car for the machine-gun belongs to this group. Its two engines each develop 250 horse-power. The Fokker, capable of 60 to 100 miles per hour, is also one of the fighter-type aeroplanes.

The third group of German aeroplanes is intended for reconnaissance. The machines all carry wireless apparatus, and act as spotters for artillery.

Following a very brief and unsatisfactory survey of British, American and Italian aeroplanes is a discussion o French aviation. Contrasting aviation witl gunnery, the author cites the latter as ai instance of an art based on scientific knowledge, whilst it is said that until an aeroplane has been made and tested it is no possible to form any trustworthy estimate of it speed, stability, or sensitiveness to controls. Th defect is more important, as aviation has not an traditions; its development has been left t

Fig. 2.—The German Fokker.

private enterprise, and up to the present witho any indication of the end to be attained. T result has been to stimulate competition betwe constructors without collaboration. If su a picture of the position of French aer nautics is even approximately true, it is di cult to believe that Britain has yet lost h superiority in the domain of design and co struction.

THE DAYLIGHT SAVING SCHEME.

CONSIDERATION is again being given to the principle of ensuring the utilisation of a larger number of hours of daylight in the summer months by putting forward the hands of timepieces by one hour during a period made compulsory by legislation. It was announced a few days ago that, by order of the Federal Council in Germany, all clocks there will be put forward an hour at 11 p.m. on April 30, and put back an hour at 1 a.m. on October 1. The French Chamber of Deputies has voted unanimously for a similar proposal, and a committee of the Senate has been appointed to consider it. Also, the Home Secretary stated in the House of Commons on April 17 that the question of taking the same step here is receiving the attention of the Government.

It is possible that the committee of the French Senate will report against the adoption of the proposed alteration of standard time; and substantial reasons for doing so can be found in a critical survey of the whole subject presented to the Paris Academy of Sciences, on April 10, by M. Ch. Lallemand. The supposed advantages of the daylight saving scheme are examined and criticised, and the conclusion reached is strongly adverse to the proposed change. It is shown that many of the advantages claimed are illusory. In France more than four-fifths of the population in the open country and smaller towns regulate their habits by the sun rather than by the clock; foundries and factories running continuously over the twenty-four hours would be unaffected. On the other hand, the advantages of such a scheme have already been realised in a simpler manner in French schools, colleges, and barracks, where it has been customary for a long time to rise one hour earlier in the summer.

We have dealt with the daylight saving principle on many occasions and have stated the fundamental objections to it. The scheme originated with the late Mr. W. Willett; and his persistent advocacy of it led to the introduction of a Daylight Saving Bill in the House of Commons in 1908. The Bill passed its second reading and was reported on favourably by a Select Committee, but it failed to reach the final stages in the House. It was re-introduced in the following year, when a Select Committee reported against it, and again it failed to pass. In 1911 the scheme was once more brought before the House under the title of the Summer Season Time Bill, only to be dropped at the end of the session. This Bill provided that "Greenwich mean time, as used for the purposes of astronomy and navigation, shall not be affected"; but otherwise the legal times of the United Kingdom of Great Britain and Ireland were to be advanced by one hour on the third Sunday in April in each year and put back by the same amount on the third Sunday in September. Every spring since then the advocates of this legislative measure have renewed their activities in the Press; and this year the circumstances of the war have given them an exceptional opportunity of stating their argument that great saving in fuel used for lighting would be effected by making the daylight saving scheme compulsory.

We do not propose to attempt again to explain why the scheme is fundamentally unsound and scientifically undesirable, but it may be worth while to state categorically some of the main objections to it. These are as follows:

(1) A very large part of the population of our islands already makes full use of the daylight available in the different seasons, by adapting their hours of work to the hours of daylight. This is the case in all agricultural districts, and also in the building, engineering, and other trades which cannot be carried on easily in artificial light. The proposed Act of Parliament would thus not effect any daylight saving in these occupations; and wherever artificial illumination is easy and convenient, working hours will always tend to be independent of the position of the sun.

(2) Practically all the civilised nations of the world use a system of time-reckoning based upon the Greenwich meridian, their times being so many hours or half-hours behind or in advance of Greenwich time. If a periodical change of the time-standards in various months by different countries became the fashion, chaos would take the place of the present orderly system. There would be a kind of game of general post at certain periods of the year, each nation taking the time of its next eastern neighbour. Our prime meridian, accepted by nations as regulating the time of the world, would be discarded by us for five months in every year, in total disregard of existing well-considered and well-established international relations.

(3) The scheme would be applied to the whole of Great Britain, though north of Edinburgh there is little real darkness for a couple of months in the summer. All places north of Edinburgh have twilight all night from the end of April to the end of July, and there would be no advantage whatever in calling nine o'clock ten during those months. When the effect of latitude upon the length of day is considered, little support can be found for including Scotland in the scheme. On account of difference of latitude, Scotland has already a natural extension of the daylight hours in the summer months without any need for legislation.

(4) The duration of daylight in the third week of April is quite different from that of the third week in September. The corresponding parts of the year as regards length of day are the third week of April and the third week of August, or the third week of March and the third week of September.

(5) As Greenwich mean time would continue to be used for times of sunrise, sunset, moonrise, lunar changes, tides, and other phenomena of astronomy and navigation recorded in calendars and tables, the difference between this and clock-

time would often lead to great confusion. Boat-trains would run according to the mid-European time, but the tides would be stated in Greenwich mean time. In most seaport towns a time-signal is used for the convenience of vessels in port, and is also valuable to the public. Would the signal always be given according to Greenwich mean time, or would it mark the changed hour during certain months of the year? It would often be difficult for local bodies to decide whether the interests of navigators or those of the public ought to determine the hour at which the time-signal should be given. Lighting-up times would be in like confusion, for they are determined by the times of sunset, which belong to astronomy, whereas the times in use would be those of the Greenwich or mid-European meridians according to the period of the year.

(6) Artisans who have to be in workshops at 6 a.m. would begin work at what is really 5 a.m., and therefore most of them would have to rise at about 4 a.m. This means that they would have to get up in the dark more than twice as often under the daylight saving scheme as they do now. The difference would be particularly noticed in the last month of the period. The six o'clock artisans would have to suffer the discomforts of additional darkness in the early morning in order that people who are asleep when they have done a quarter of a day's work may have additional daylight at the other end of the day.

(7) For several weeks of the period over which the proposed advance of time would be effective additional fuel would be consumed for heating in the early morning, and this amount, as well as the additional lighting required by many thousands of artisans getting up in the dark, is overlooked when the saving of artificial illumination at night is put forward as a plea for the adoption of the scheme. The heat meridian is about two hours after the light meridian; and possibly it has determined the customary time-table here, as it does the social arrangements of other countries of Europe, as well as in the Tropics.

(8) Though hundreds of corporations and councils have expressed their desire to have the 154 additional hours of daylight per annum promised by the scheme, not a single scientific society or other body with expert knowledge has supported it. The public may demand whatever legislation it pleases, without regard for the consequences; but, in the words of the Select Committee which reported upon the Daylight Saving Bill of 1909, "having regard to the great diversity of opinion upon the proposals of the Bill and to the grave doubts which have been expressed as to whether the objects of the measure can be attained by legislation without giving rise, in cases involving important interests, to serious inconvenience," it will be a pity if the circumstances of the war should lead Parliament to adopt a measure which has been twice rejected already after full discussion.

THE IMPERIAL INSTITUTE.

THE Imperial Institute (Management) Bill, which received the Royal Assent on April 18, provides for the transfer of the property and management of the Imperial Institute from the Board of Trade (in which these were vested by the Act of 1902) to the Colonial Office. Mr. Bonar Law, in a speech on the second reading in the House of Commons, explained that in view of the commercial reorganisation which would take place after the war the Government desired that the valuable work of the institute should be supported by a larger and more representative governing body, on which each of the Dominions, India, and the Crown Colonies would be represented, as well as the Colonial Office, the Board of Trade, the Board of Agriculture, and the India Office, whilst representatives of the commerce and industry of the United Kingdom would also be nominated on the executive council, which will consist of twenty-five members. Among the speakers at this stage, and afterwards in Committee, were Sir J. D. Rees, Sir John Jardine, and Colonel Yate, all of whom proposed increased representation of India, and Sir Philip Magnus, who asked for the appointment of representatives both of the Imperial College of Science and Technology and of the University of London.

It was announced that the member selected by the Committee of the Privy Council for Scientific and Industrial Research would be nominated by the Secretary of State for the Colonies, and that of the other nominees of the Secretary of State one would be an Indian member in addition to Lord Islington, the Under-Secretary of State for India, which would give India five members in all.

The second reading of the Bill in the House of Lords was moved by Lord Islington, who fully explained the intentions of the Bill and spoke in high terms of the value of the work of the institute to the commerce of the Empire. Viscount Milner supported the Bill, and expressed the hope that in future the institute would be better supported with funds to aid the extension of its important work, a view which was also expressed by Viscount Peel and Lord Sudeley. In Committee Lord Sudeley moved an amendment to make Ministers of the Dominions, Governors of Crown Colonies and Protectorates, and members of the Viceroy's Council in India when at home on leave, *ex-officio* members of the executive council. This was not accepted by the Government, who however, agreed to invite the persons specified to attend the meetings of the executive council.

THE SUN'S ROTATION.[1]

AN interesting contribution to the investigation of the sun's rotation by the spectroscopic method has been made by Mr. J. B. Hubrecht in an extended discussion of a series of plates taken by him with the McClean equipment a

[1] Annals of the Solar Physics Observatory, Cambridge. Vol. iii., Part The Solar Rotation in June, 1911, from Spectrographic Observations ma with the McClean Solar Instruments. By J. B. Hubrecht. Pp. 77. (Cambridge: At the University Press, 1915.) Price 9s. net.

Cambridge in June, 1911. The photographs in question are unique, inasmuch as in place of the usual comparisons at opposite points of the limb, they compare the spectra at points 90° apart, at intervals of 15° completely round the sun. By this arrangement the velocities in the two hemispheres may be separately derived, and Mr. Hubrecht concludes that at the period of these observations the velocities were greatest in the northern hemisphere. Thirty lines, belonging to seven elements, and including four enhanced lines, were measured, and no departure from average results was found for any of them. There was, however, a distinct diminution of the indicated velocity with increase of wave-length, for which no definite explanation can yet be given. In relation to heliographic latitude, the results are remarkable as showing uniform angular velocity from 15° N. to 15° S., and, following the usual decline to higher latitudes, a slight increase between latitudes 60° and 75°. The deduced angular velocities as a whole are also considerably smaller than those derived at Mt. Wilson, and the equatorial velocity is assigned the correspondingly low value of 1·85 km. per second.

These departures from the average results of other observers were constant throughout the period of observation, and there is evidence that they were not due to local disturbances; Mr. Hubrecht appears to regard them as possibly associated with temporary conditions in the sun, and believes that his results are consistent with Emden's theory.

A somewhat remarkable feature of Mr. Hubrecht's memoir is its appearance as vol. iii., part i., of the Annals of the Solar Physics Observatory, Cambridge, since it refers to data obtained before the transfer of the Solar Physics Observatory from South Kensington, and discussed after the author had left Cambridge. Vols. i. and ii. of these Annals have not yet been issued, and we have been unable to ascertain what their contents will be.

NOTES.

We learn with much satisfaction that the announcement of the death of Prof. I. P. Pavlov is incorrect; and we may hope, therefore, that the record of his work given in Nature of March 2 will be extended still further in the coming years. Prof. B. Menschutkin, of the Polytechnic Institute, Petrograd, writing on March 20, informs us that Prof. Pavlov is alive and well, and that the Prof. Pavlov who died in February was Eugeni Vasilievitch Pavlov, a celebrated surgeon. The name of Pavlov is common in Russia, there being no fewer than five professors of that name in Petrograd, so that the mistake in the *Times* of February 12 is quite comprehensible.

The death is announced, at Ottawa, of Dr. W. F. King, chief astronomer, Department of the Interior, Canada, and director of the Dominion Astronomical Observatory; also of the Rev. J. B. McClellan, formerly principal of the Royal Agricultural College, Cirencester.

The bronze tablet placed in St. Paul's Cathedral to the memory of Captain Scott and his companions will be unveiled by the Prime Minister on Friday, May 5.

A conference on engineering and scientific research will be held at Caxton Hall, Westminster, on Monday next, May 1, at 5 p.m. The conference will be opened by Prof. J. A. Fleming, and a number of leading representatives of engineering science are expected to take part in the discussion.

His Excellency Lord Carmichael has accepted the chairmanship of the trustees of the Indian Museum for the year 1916–17. The Hon. Justice Sir Asutosh Mookerjee has been elected vice-chairman, and the Hon. Raja Rishe Case Law honorary treasurer.

The council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1915–16:—A Telford gold medal to Sir John Benton (Eastbourne); a Watt gold medal to Sir George Buchanan (Rangoon); a George Stephenson gold medal to Mr. F. W. Carter (Rugby); and Telford premiums to Mr. C. Carkeet James (London), Mr. D. E. Lloyd-Davies (Cape Town), and Mr. W. T. Lucy (Oxford).

We learn with regret that Mr. C. Lees Curties, late partner in the well-known firm of Charles Baker, High Holborn, London, W.C., scientific instrument manufacturer and agent, died on April 24, at fifty-five years of age. We are informed that the business will be carried on as usual, under the same title, by the remaining partners—Mr. T. Hale Curties and Mr. C. Lees Curties, jun.

The President of the Board of Trade has appointed a Committee to control the supply and distribution of petrol, and to consider what measures are necessary in the national interest (1) to ensure that adequate supplies of petrol shall be available for the purposes of the war and for other essential needs; (2) with the above object to regulate the use of petrol for other purposes in the United Kingdom during the period of the war; and, subject to the direction of the Board of Trade, to give executive effect to the measures decided on. The Committee consists of Mr. O. Bury (chairman), Mr. A. E. Bowen, Sir John P. Hewett, and Mr. P. G. L. Webb. Mr. H. W. Cole, of the Board of Trade, will act as secretary to the Committee.

The President of the Board of Trade has appointed two further Committees to consider the position of certain branches of British trade after the war, with special reference to international competition, and to report what steps, if any, are necessary or desirable in order to safeguard that position. These Committees are:—*For the Textile Industries*:—Mr. Henry Birchenough (chairman), Sir F. Forbes Adam, Mr. J. Beattie, Mr. T. Craig Brown, Mr. E. B. Fielder, Mr. J. W. Hill, Mr. A. Illingworth, Mr. J. H. Kaye, Mr. E. H. Langdon, Mr. J. W. McConnel, Mr. H. Norman Rae, Sir Frederick Smith, Bart., Mr. T. C. Taylor, Right Hon. Robert Thompson, Mr. F. Warner. Mr. T. M. Ainscough will act as secretary to the Committee, and all communications relating to it should be addressed to him at 6 Whitehall Gardens, S.W. *For the Electrical Trades*:—Hon. Sir Charles A. Parsons (chairman), Mr. J. Annan Bryce, Mr. T. O. Callender, Mr. J. Devonshire, Mr. B. M. Drake, Sir John Snell. All communications should be addressed to the secretary, Electrical Trades Committee, at 7 Whitehall Gardens, S.W.

The tragic death of Major W. L. Hawksley, R.A.M.C., whilst on active service in France, removes from the service of the Liverpool Corporation a bril-

liant assistant medical officer. Dr. Hawksley had always been associated with Liverpool, and was a graduate of the University of the city. His first association with the corporation was as a resident medical officer at the Fazakerley Hospital. Afterwards he held the post of assistant school medical officer, and ultimately was appointed an assistant medical officer of health to deal with problems relating to tuberculosis. Following the passing of the National Insurance Act, Dr. Hawksley naturally attained the additional position of acting chief tuberculosis officer, a post for which his previous experience gave him exceptional qualification. The harmonious relationship which now exists between the Insurance Committee and the corporation serves as a lasting monument to his unfailing tact and administrative ability, for upon his shoulders fell much of the original work of organising the Liverpool tuberculosis scheme. Of his services to his country since war was declared little is known to those at home, but, if his military duties were performed with the enthusiasm, tact, and efficiency which characterised his work as a civil servant, the loss to the Army is as deplorable as to the city of Liverpool. His interests were many-sided, for, besides the numerous committees of charitable organisations on which he served, the Atmospheric Pollution Committee has reason to feel the loss of an enthusiastic worker. All who knew Dr. Hawksley will deeply sympathise with his widow and two children in their bereavement.

The *Daily Chronicle* for April 24 gives the substance of an interesting letter sent to Prof. Lorentz, of Haarlem, by Dr. Max Planck, professor of mathematical physics in the University of Berlin, and permanent secretary of the Royal Prussian Academy of Sciences. In this letter Prof. Planck recalls the letter addressed to the civilised world in August, 1914, by ninety-three German scholars and artists, in which they defended the conduct of their own Government, and denounced in extravagant language the action of the Allies. Prof. Planck himself was one of the signatories. He now admits that the form in which this letter was written led to regrettable misunderstandings of the real sentiments of the signatories. In his opinion, and it is an opinion shared, he says, by his colleagues Harnack, Nernst, Waldeyer, and Wilamowitz-Möllendorff, that letter of appeal was written and signed in the patriotic exuberance of the first weeks of the war. It must not be taken for granted, says Prof. Planck, that at the present time anything like a scientific judgment can be formed with regard to the great questions of the historical present. "But what I wish to impress on you," he writes to Dr. Lorentz, "is that notwithstanding the awful events around us I have come to the firm conviction that there are moral and intellectual regions which lie beyond this war of nations, and that honourable cooperation, the cultivation of international values, and personal respect for the citizens of an enemy State are perfectly compatible with glowing love and intense work for one's own country."

According to the *Times* of April 20, the Behar and Orissa Government has issued an account of recent unrest among the Oraons of Chota Nagpur, which is of considerable interest to anthropologists. The unrest would seem to have been brought about by a number of causes, among them a desire to raise the tribe to the higher social level of Hindu and Christian converts, the general unrest caused by the war, and the withdrawal of German missionaries. The chief cause, however, would appear to be an effort made by the Oraons about August, 1915, to expel from their country the evil spirits which they held responsible for the bad crops and the high prices. To effect this object secret meetings were held at night by the younger men, at which powerful *mantras*, or spells, were recited. Into some of these, it is not unimportant to note, the name of the German Emperor was introduced. Acts of violence followed, and extra police were drafted into the district. But, adds the report, the process of pacification is slow, as the expulsion of evil spirits from one village leads to the alleged transfer to another. As might have been expected, the movement was followed by "witch-hunting," in which the general populace took part, as well as the *sokas*, or "witch-hunters." Several murders have taken place. The whole account is an interesting commentary on primitive psychology, with the workings of which readers of Sir James Frazer's discussions of the purification ceremony of "devil-driving," the transference of evils, and the medicine-man will be familiar. It may also serve as a further reminder, should one be needed, of the importance to officials of an understanding of the springs of action in a lower race.

In the recently issued annual report of the Decimal Association for 1915, it is stated that the past year has shown a distinct advance in public opinion in favour of the compulsory introduction of the metric system of weights and measures. It is pointed out that our manufacturers are severely handicapped as regards trade with foreign countries by the retention of our present weights and measures. As the metric system is in use in the majority of foreign markets the British manufacturer who wishes to introduce his goods into those markets is at present obliged to maintain two systems of weights and measures, both in his works and in his office. On the other hand, his competitor on the Continent employs only one system throughout, and that system is understood both by the middleman and the customer. One of the results of the war has been to familiarise the nation with the metric system to a remarkable extent. The presence of our soldiers on the Continent and of Belgian and French refugees in our midst has been an important factor in bringing this about. The nation has already had to experience so many drastic innovations that a reform of our weights and measures would not now meet with that blind opposition from the general trading community which up to the present has been apprehended by the authorities. The inconvenience experienced by the public owing to the exclusion of German and Austrian wares, especially certain classes of goods which have become almost necessaries, must have caused the nation to realise that improvement in our business methods is urgently required. The Association hopes that the Government will take advantage of the favourable opportunity which war conditions have created for introducing legislation to bring our weights and measures into conformity with those which have been proved by our competitors to be the most suitable for stimulating external trade.

The address of Sir Hugh Bell to the members of the Political Economy Club on March 1, published in the *Economic Journal* for April, is a valuable contribution, especially as coming from a great ironmaster in close competition with a great German industry, to the current controversy as to the commercial policy of this country after the war in relation to the Central Powers. Sir Hugh Bell makes it clear that the industrial advance of Germany since 1870 has been the fruit mainly of "the German system of education," which "put into the hands of the German manufacturer the means of conducting his operations in a thoroughly scientific way." "Very carefully trained chemists were turned out of the technical schools by hundreds," and the manufacturers "had the good sense to make use of the materials thus pro-

vided." "The field of inquiry was quite new, and offered boundless opportunities of research," and it was vigorously exploited, with the result which the war has made only too plainly evident. Alluding to the manufacture of dyes, regret is expressed that a great new branch of industry has passed from British control, but in this matter blame is laid upon the Government, both central and local, in the enactment of unwise restrictions, the effect of which, as, for example, in the instance of alcohol, has resulted in the serious hampering of industrial development. The great industrial prosperity of the country has also produced an attitude of indifference to scientific discovery in this and other countries, which, in the case of the latter, has silently but none the less surely laid the foundation of great industrial enterprises. "There has never been," says Sir Hugh Bell, "during the last fifty years a time of any duration when it would have been possible to get 10,000 capable workmen to take up new work. There have been plenty of unemployed, but they were persons who, under the conditions existing, were unemployable." There could scarcely be a more eloquent testimony to the need, or a more adequate spur, for a better organised scheme of education by means of which we could create a great reservoir of rightly educated men. We need the vision without which a nation must perish.

THE Cuzco valley in southern Peru has become known for its vertebrate remains embedded in comparatively recent gravels (see NATURE, vol. lxxxix., p. 584, and vol. xci., p. 615). The Yale expedition was mainly concerned with the antiquity of man, but Mr. H. E. Gregory was enabled to extend his researches to the geology of the valley and its relation to the Andean chain. In the *American Journal of Science*, vol. xli. (1916), p. 19, he presents a new conception of the Andes as an uplifted plateau of continental and marine sediments penetrated by igneous intrusions, the surface of erosion having little regard to geological structure. The deep dissection of this late Mesozoic surface has cut "a number of canyons rivalling the Grand Canyon of the Colorado in depth and ruggedness." The Urubamba has trenched the plateau to a depth of more than 5000 ft. The Cuzco valley is an incident of the plateau, where faulting has helped to produce a depression, in the upper part of which a lake was at one time formed by downwarp.

IN the interior of Borneo much exploration remains to be done. Mr. J. C. Moulton, Curator of the Sarawak Museum, has put together an account of the various expeditions to Mount Kinabalu, British North Borneo, from 1851 to his own expedition in 1913 (*Sarawak Museum Journal*, vol. ii., pt. ii., September, 1915). The article is accompanied by a map showing the best routes to the mountain, and contains a good deal of new information, much of it collected from native sources. The same number of the Journal contains a number of valuable articles on the natural history, botany, and zoology of Borneo.

FURTHER evidence that some at least of our British swallows (*Hirundo rustica*) winter normally in the extreme south-east of Africa has come to light by the recovery, near Grahamstown, on February 6, 1916, of a bird which was ringed by Mr. F. W. Sherwood at Lytham, Lancashire, on July 3, 1915. This, remarks Mr. H. F. Witherby, in *British Birds* for April, is the third swallow which has been reported from South Africa similarly marked for identification. The first was ringed as an adult at Rosehill, Cheadle, Staffordshire, on May 6, 1911, and was caught on a farm near Utrecht, Natal, on December 27, 1912. The second was ringed as a nestling at Skelmorlie, Ayrshire, on July 27, 1912, and was caught at Riet Valley, Orange Free State, on March 16, 1913.

SOME useful work on Indian Cestoda, by Mr. T. Southwell, appears in the Records of the Indian Museum, vol. vii., part 1, 1916. The author describes a number of species found in Indian fishes, birds, and mammals. He confines his remarks to the anatomical characters of adults. The larval stages, indeed, of many of the species herein surveyed are unknown. More particulars in regard to the hosts of these parasites would be acceptable. Where information on this head is lacking it would be of distinct advantage to say so. The same issue contains a paper by Major R. E. Lloyd and Dr. N. Annandale on the brackish-water hydrozoon, *Campanulina ceylonensis*. The authors have been enabled to work out the complete life-history of this interesting species, and thereby they have discovered that the form described by Browne under the name *Irene palkensis* is really but a senile stage of *ceylonensis*.

KEW BULLETIN, No. 1 for 1916, contains a useful paper on the African species of the genus Morinda (Rubiaceæ) by Mr. S. Hutchinson. Four species are now recognised, a new one, *M. confusa*, being described in the paper. Owing to the excellent material sent home by Mr. Lane-Poole, Conservator of Forests, Sierra Leone, the country inhabited by three of the species, it has been possible to draw up careful diagnoses. The fourth species, *M. lucida*, Benth., is not known further north than the Gold Coast. The Sierra Leone species are found in the rain forests of the colony. The species are used medicinally for various purposes, but especially for fever, *M. geminata* having a reputation as being efficacious in cases of yellow fever. The distinctive characters of the four species are well shown in a series of text figures.

AN important memoir on the Avezzano earthquake of January 13, 1915, has been communicated by Prof. E. Oddone to the Italian Seismological Society (*Bollettino*, vol. xix., 1915, pp. 71–215). On the small-scale map which illustrates the paper, the isoseismal lines of the epicentral area are shown, the intensity being determined by reference to the Cancani duodecimal scale. In this district there are two chief areas of destruction. The northern area, in which the intensity of the shock reached the degree 12, lies in the basin formerly occupied by the lake of Fucino, and extends from the neighbourhood of Avezzano to that of Lecce. The southern area, in which the intensity was usually 10, but in places 11, lies along the Val Liri. Prof. Oddone attributes the remarkable variations of intensity in the epicentral district mainly to orographic and geological conditions, and not to the existence of separate centres of disturbance. The directions of the movement diverge from an epicentral area a few kilometres in length and elongated from north-west to south-east, the centre of the area being in 41° 58′ N. latitude, 13° 36′ E. longitude, or about 16 km. to the south-east of Avezzano. The ground in this district is broken up by numerous fissures, the most remarkable of which is a perimetral crack, following approximately the course of the isoseismal 12. The crack, which has been traced almost uninterruptedly for 70 km., is usually from 30 to 100 cm. in width, the ground within it (that is, towards the Fucino) being depressed relatively by 30 to 90 cm. The duration of the earthquake, scarcely exceeding five seconds, was one of the shortest of known destructive earthquakes. Prof. Oddone estimates the depth of the focus at approximately 10 km.

THE existence of reindeer in Spitsbergen has never been satisfactorily explained, and is a vexed problem

in geographical distribution. M. Adolf Hoel has a paper on the subject in *La Geographie* for December, 1915 (vol. xxx., p. 6). His contention that the Spitsbergen reindeer have come from Novaya Zemlya *viâ* Franz Josef Land is supported by a single piece of evidence, but a very strong one. In 1912 an old male reindeer was shot in Spitsbergen that had attached to one of its horns by a piece of cord the foot of an ivory gull. It also had incisions on its ears. There can be no doubt that these markings on the horn and ears were the work of Samoyedes on Novaya Zemlya, who are accustomed to distinguish certain members of their herds in this way. Other reindeer with marked ears are said, but on less secure evidence, to have been shot in Spitsbergen. In any case, this particular deer was not brought from Novaya Zemlya by man. From Novaya Zemlya to Franz Josef Land is about 240 miles, from Franz Josef Land to King Carl Land about 210, and to Edge Island, Spitsbergen, another 55 miles. Winter ice would certainly permit such a journey, but the difficulty is to believe that a reindeer could travel 240 miles without food. However, M. Hoel's explanation seems the only possible one. A passage direct from Lapland to Spitsbergen would be impossible, if only because there is never continuous ice.

Part 2 of vol. xxviii. of the Proceedings of the Physical Society of London contains thirty pages, twenty of which are devoted to the Guthrie Lecture delivered at the end of January by Dr. W. B. Hardy, secretary of the Royal Society. He chose for his subject some of the physical problems raised by the study of living matter. He showed, for example, how the growth of the severed end of a nerve towards its corresponding end is determined by small differences of concentration of some substance diffusing out from the severed ends. The phenomena of growth depend on the presence of minute quantities of substances known as vitamines, often found exclusively in the rinds or skins of grains and fruits, and Dr. Hardy drew a parallel between their action in determining growth and the effect of throwing a few crystals into a supersaturated solution. The remainder of the part is devoted to a short paper by Prof. Lees on a generalised bridge for the comparison of the self and mutual inductances of two coils, and another by Dr. Sand on a cadmium arc lamp similar in principle to the mercury arc lamp.

In 1911 a paper was read before the International Photometric Commission by W. J. A. Butterfield, J. S. Haldane, and A. P. Trotter, describing some careful experiments on the Pentane and Hefner standard lamps. By enclosing these lamps in a special chamber the effect on the light of carbon dioxide, aqueous vapour, and barometric pressure could be conveniently studied; with the great advantage that variations far greater than those met with in practice could be produced, and the resultant changes in candle-power studied on a large scale. In the case of the Pentane lamp the results obtained were in close agreement with those previously reported by C. C. Paterson at the National Physical Laboratory. But the correction for the effect of carbon dioxide and change in barometric pressure on the Hefner lamp were found to be respectively three times and four times that previously assumed by Liebenthal. This question has since been studied by Dr. Ott, of Zurich. With the view of securing exceptional variations in barometric pressure experiments were first made at various stations in high altitudes, but eventually the method of employing a compression chamber was adopted. A change of barometric pressure from 816 to 717 mm., which is the most important range from a practical viewpoint, produced a variation in the candlepower of the Hefner lamp of only 1·1 per cent. This is in close agreement with Liebenthal's formula. But from 717 mm. to 614·5 mm. the variation in candle-power was found to be much greater, and the average effect for the entire range of 816–614·5 mm. approximated very closely to the figure given by Butterfield, Haldane, and Trotter. As regards the effect of carbon dioxide Dr. Ott agrees with these observers in finding the factor given in Liebenthal's formula too small, but this arises from the fact that the presence of much carbon dioxide is in practice usually due to the vitiation of the air of the photometer room. The light is thus affected by deficiency of oxygen as well as the carbon dioxide. Well-ventilated and sufficiently large rooms are therefore essential for standard work.

The accurate measurement of the vapour pressure of ice at low temperatures is a problem of considerable difficulty, not only on account of the smallness of the values involved, but also because of the adsorption on glass surfaces and of the thermal molecular pressure. These difficulties appear to have been overcome in a very satisfactory manner by S. Weber (*Kgl. Danske Videnskabernes Selskabs Forhandlinger*, No. 6, 1915, Copenhagen). The pressure, down to 205° absolute, was measured by means of the loss of heat from a hot Wollaston wire, and below this temperature by Knudsen's absolute manometer. It was also checked more roughly by means of a mercurial manometer with optical contacts, reading to 3μ. The residual pressure in the apparatus at 143–163° abs. was 0·053–0·070 dyne per square centimetre for ice from conductivity water, and about half this for ice prepared inside the apparatus from pure hydrogen and oxygen. After correcting for this residuum, which is unaccounted for, an extremely good agreement with Nernst's empirical formula was obtained, down to 175° abs. The same number of the above Journal contains the fifth of a series of papers by C. Christiansen on the frictional electricity generated by drops of a liquid falling on a platinum plate. The effect is much greater for solutions of non-electrolytes (mercuric cyanide, triamminocobaltinitrite) than for those of electrolytes (mercuric chloride, hexamminocobaltichloride).

In a paper entitled "Theory and Practice in the Filtration of Water," read to the Institution of Mechanical Engineers on April 14, Mr. W. Clemence attempts to prove that the multiple filtration process invented by MM. Puech and Chabal is economically and hygienically the most efficient process of water purification. The process consists of passing the water through a series of filters filled with material ranging from coarse gravel in the first to fine sand in the last, the greater part of the suspended matter in the water being retained by the earlier elements, so that no film forms on the surface of the final sand filter, the work of purification being effected by nitrifying organisms in the body of the sand, thus differing from other processes, which depend largely on the straining effect of a surface film formed by natural or artificial means. While making the best case he can for the multiple process—and on the whole a good case—the author scarcely does justice either to mechanical or ordinary slow sand filtration. Most water experts now agree that these latter processes cannot be taken as the "only line of defence" against water-borne disease, but with an initially "safe" water the improvement in appearance and the removal of oxidisable matter effected particularly by mechanical filters are often most marked. On the other hand, it is claimed that the multiple process is capable of rendering safe an

unsafe water, although no conclusive evidence in the way of figures is brought forward to prove it. Indeed, throughout the paper, which gives in considerable detail the results of tests made on multiple filtration plants in different parts of the world, there is no mention of any tests being made for *B. coli*.

THE Health of Munition Workers' Committee has issued a memorandum on special industrial diseases in which it is stated that the work of certain industrial processes entails risk of serious, and possibly fatal, illness from exposure to lead, ethane tetrachloride, nitrous fumes, and certain explosives, whilst contact with trinitrotoluol, tetryl, mercury fulminate, and certain lubricating and cooling liquids used in metal turning may produce dermatitis. The provision of facilities for the prompt treatment of all cases of sickness and injury is recommended. Operatives engaged in manufacturing or handling trinitrotoluol have been found affected with unusual drowsiness, frontal headache, eczema, and loss of appetite. The symptoms are generally slight at first, and disappear when exposure ceases, but in exceptional cases sudden collapse may occur after a few hours' work on a hot day. The symptoms are intensified by continued exposure, and in a few cases profound jaundice and even death have resulted. T.N.T. may be absorbed by the lungs, skin, or digestive tract, in the form of vapour or dust, and certain preventive measures are specified.

BULLETIN No. 266 of the Scientific Papers of the Bureau of Standards, by Messrs. Cain, Schramm, and Cleaves, deals with the preparation of pure iron and iron-carbon alloys. The authors have worked out methods of producing laboratory samples of iron-carbon alloys of a very high degree of purity; sources of contamination of melts and means of eliminating them are described; a method of preparing magnesia of a satisfactory degree of purity for making crucibles to be used in work of this kind has been developed; and a procedure for making small ingots, which are sound and free from blowholes, without the use of deoxidisers, has been worked out. A series of iron-carbon alloys containing 99·96 per cent. of the two elements has been prepared to serve as a basis for the redetermination of the iron-carbon equilibrium diagram.

IN Bulletin No. 60 of the Technological Papers of the U.S. Bureau of Standards, H. S. Rawdon describes the microstructural changes accompanying the annealing of cast bronze (Cu88, Sn10, Zn2). The alloy is first brought into physico-chemical equilibrium. The dendritic structure persists until heated for approximately two hours at 800° C. The absorption of the eutectoid depends much on how the sample cooled on freezing. No evidence was found suggesting a change of crystal size of cast samples which had not been distorted in any way. Recrystallisation, including twinning, was found only to follow distortion or its equivalent. Metal cooled suddenly from the molten state behaves similarly because of the high internal stresses resulting.

MESSRS. CASSELL AND CO., LTD., have ready for publication "Alfred Russel Wallace: Letters and Reminiscences," by J. Marchant. The volume will contain a number of hitherto unpublished letters, reminiscences from various friends, and a sketch (from his son and daughter) of Dr. Wallace's home life. The evolution of the idea of natural selection is traced up to the time when the papers on the subject by Darwin and Wallace were communicated to the Linnean Society, and Dr. Wallace's other scientific work is dealt with in the volume.

OUR ASTRONOMICAL COLUMN.

THE PLANET MERCURY.—This planet will be at greatest E. elongation on May 12, 21° 36′ E. from the sun. It will continue above the horizon about two hours after sunset. Maximum conspicuousness occurs several days *before* the elongation.

COMET 1916*a* (NEUJMIN).—Observations, including an arc of thirty-seven days (February 27–April 4), have been employed by M. J. Braae in calculating a new orbit for this comet. The second and third places are based on observations made at Bamberg (March 23) and Neu Babelsberg. The modifications of the earlier orbit are all in the direction of the Berkeley orbit noted last week, consequently the differences between the respective ephemerides have been considerably reduced. According to Copenhagen Postcard No. 17 the new orbit is :—

$$T = 1916 \text{ March } 11{\cdot}2350 \text{ G.M.T.} \quad P = 2008{\cdot}8 \text{ days } (5{\cdot}50 \text{ y.})$$
$$\mu = 645{\cdot}163''$$

Epoch 1916 Jan. 0·5 G.M.T.	Equinox 1916·0
$M_0 = 347° \ 19' \ 24{\cdot}5''$	$\omega = 193° \ 43' \ 17{\cdot}7''$
$\phi = \ 34° \ 43' \ \ 4{\cdot}7''$	$\Omega = 327° \ 30' \ 59{\cdot}6''$
$\text{Log } a = \ 0{\cdot}493559$	$i = \ 10° \ 39' \ 53{\cdot}0''$

Ephemeris (Messrs. J. Braae and J. Fischer-Petersen), Greenwich midnight :—

	R.A. h. m. s.	Decl. ° ′
April 28	10 20 36	− 9 41·9
30	24 59	10 10·7
May 2	29 24	10 38·7
4	33 51	11 5·9
6	38 21	11 32·3

Log Δ April 26, 9·7979, May 4, 9·8386

Observations made at the Hill Observatory, Sidmouth, on April 20 and 22, were represented by this ephemeris within the limits of accuracy attainable in the measures. On April 22, the sky being especially clear, the comet still showed a considerable diffused coma and a feeble condensation was glimpsed.

THE IRREGULAR VARIABLE STAR, T TAURI.—The annual report of the director of the Mount Wilson Solar Observatory for 1915 bears more resemblance to a review of the world's work in astronomical physics than the report of a single institution. The summary contains seventy-eight important items. No. 61 states that the irregular variable star, T. Tauri, is surrounded by an extensive atmosphere 4″ in diameter, which shows the bright lines characteristic of Wolf-Rayet stars. The spectrum of the star proper is about F5. The magnitude of this remarkable object ranges between 10·3 and 13·2. Notwithstanding the impressive output of work it appears there is room for regret —the 60-in. reflector remains the only instrument for work on stars and nebulæ, but it is offset by a crescendo of hope—the 10-in. portrait lens telescope is nearly ready, and the 100-in. reflector is expected to be in working order by the end of 1916.

A NEW VARIABLE STAR HAVING NEBULOUS ENVELOPE. —An addition to this at present very limited group of extremely interesting objects is announced by Mr. R. T. A. Innes in Circular No. 33 of the Union Observatory. The star is −37° 8450 in the Southern Crown, and normally its magnitude is 8·7, but on two occasions last year, October 29 and November 24, it was considerably fainter (12·4 and 11·5 respectively). The nebulous envelope was also found to vary. The 6·88 magnitude star, −37° 8449, possesses a similar appendage, and is so near to the above as to touch, thus affording an excellent basis for comparison. It is tantalising to think that these stars actually come above our horizon.

THE INDIAN SCIENCE CONGRESS.

THE proposal to assemble an Indian Science Congress was first put forward in 1913, and was due to the initiative of Prof. MacMahon and of Dr. Simonsen. The support of the Asiatic Society of Bengal gave to the new scheme a prestige which has helped it materially. The first congress was held at Calcutta in 1914, the second at Madras in 1915, and the third has recently been held at Lucknow. The future development of these congresses will be watched with interest by all who are engaged in scientific work.

India is struggling to devise an educational system that will satisfy her peculiar and complicated requirements; in her endeavours she has been the recipient of much criticism and advice; other countries have been held up to her as models, and she has been urged to adopt, for her numerous races and her tropical climate, methods that have been found suitable to homogeneous northern peoples.

Amid the clamour of politicians quarrelling over questions of primary education, the Government of India has had to consider the teaching of science at colleges and universities, and the prosecution of research in its scientific departments. In the last twenty years many well-qualified professors of science (physics, chemistry, zoology, medicine, mathematics) have been appointed, the Science Institute at Bangalore has been founded by the late Mr. J. N. Tata, the Research Institutes at Dehra Dun and Pusa have been erected and officered. In 1902, in order to prevent the duplication and overlapping of work, and in order to promote co-operation and touch, Lord Curzon created the Board of Scientific Advice, upon which each scientific department of State is represented.

The expansion of scientific teaching and work in India has created new wants, and the absence of scientific societies and of scientific libraries has now begun to be felt. Although the Board of Scientific Advice may prevent the Forest Department in its researches from overlapping the Agricultural Department, it does not bring the scientific departments into touch with the universities and colleges, and it does not bring together individuals who are working at the same branch of science.

If the Government of India had made no efforts to push on the teaching of science, it would have been blamed for supineness; now, however, that it is showing enterprise and determination, it is criticised for giving scientific education without providing a career or a livelihood for the youth whom it educates. It is pointed out that the educated youth of India is crowding into the legal profession, because it is the only learned profession that holds out a prospect of money-making. This statement is, however, no longer quite correct, as the medical profession is beginning to offer great chances to young men of ability. In every civilised country the public are willing to pay large fees to men who can save them from illness or can protect them in the law courts; and this fact will always render the legal and medical professions popular and lucrative.

The word "research" is now in common use, but what is meant by "research"? Some authorities, influenced by the commercial success of foreign medicines and of synthetic indigo, urge that research must be utilitarian; others are contending that science must be pursued for love of science only. Enough has been said to show the difficulties of the situation in India. In such a situation an annual congress of all interested in science cannot fail to be advantageous. Twenty years ago such a congress would not have been possible; twenty years hence it will have created for itself a powerful position.

In India workers in science are scattered to an extent which residents in England can scarcely realise. It is desirable that they should become personally acquainted. Without libraries and without intercourse individuals cannot keep abreast of the times. A congress meeting affords an opportunity for workers from every part of India to meet together and to discuss their difficulties, and is of particular value to the younger workers, in that they are able to present their results to audiences capable of offering sound criticism. Trained students from the Indian colleges are able at a congress to obtain information concerning chances of employment.

The recent congress at Lucknow was well attended by both Europeans and Indians, and the discussions showed great and general interest. Colonel Selby, the principal of the Medical College, had kindly placed some of his buildings at the disposal of the congress, which was opened on January 13 by Sir James Meston, the Lieutenant-Governor of the United Provinces. Sir Sidney Burrard was the president, and in his address he discussed the origin of the mountain ranges of India. The congress then separated, and meetings of its several sections were held—Agriculture, Zoology, Chemistry, Botany, Physics and Mathematics, Geology and Ethnology. It would serve no useful purpose to give complete lists of the papers read in the various sections. A report of the meeting, with abstracts of the papers read, has been published in the Journal of the Asiatic Society of Bengal for February, 1916.

From the papers presented to the Chemistry Section, it is clear that both among the European and Indian members of the teaching staffs at the various colleges and institutions, a keen desire to carry out chemical investigations exists, a desire which is shared also by the senior students of some of the colleges. Among the centres where such activity is pronounced are Calcutta, Madras, Dacca, and Bangalore. The growth of this desire to participate in chemical research has been most marked during the past few years, and the activity at present is such that materials for papers and discussion at subsequent meetings of the congress are assured.

In the Physics Section the attendance was large. Papers were read on atmospheric electricity; radioactivity of rocks; electrical discharge in gases; the oscillations of a violin string, and the history of mathematics, showing that the range of work was wide. The papers were of a high standard, and indicated that research in the physical sciences is healthy in India. Of the researches described in the papers read, four were made in Government scientific departments and eleven in university colleges. The meetings acted as a stimulus to those taking part in them.

Lucknow being a large city, the committee of the congress arranged for three lectures to which the public were admitted. The first was by Dr. Hankin, on the evolution of flying animals; the second by Dr. Bose, on invisible light; and the third by Prof. Neogi, on the manufacture of iron in ancient India.

With a record of three successful meetings, it seems clear that the Science Congress has established itself as a valuable aid to scientific progress in India. In the future it is perhaps possible that it may develop on broader lines and eventually grow into an Indian Association for the Advancement of Science, with greater scope for promoting scientific inquiry and co-operation. All who have been engaged in scientific work in India will realise the great benefits which might be conferred by such an association.

THE GLACIAL THEORY OF CORAL REEFS.[1]

SUESS'S demonstration that many of the relative changes of land and sea may be due to variations in the height of the sea, while the land remained stationary, and his suggestion that Darwin's theory of coral reefs was as consistent with a rise of the sea surface as with a subsidence of the sea floor, were followed by various attempts thus to explain the phenomena of coral islands. This explanation has now received its strongest support in a valuable memoir by Prof. R. A. Daly, who brings to the problem his usual thoroughness and ingenuity. His interest in the question was roused by the coral reefs of the Hawaiian Islands, which are so small that they are clearly young, and were probably all formed after the disappearance of the glaciers that once existed around the summit of Mauna Kea.

After some years of careful study, Prof. Daly concludes that the coral reefs of the world consist of a thin veneer of coral limestone resting on a great submarine bank; and he holds that the fundamental problem is the origin of these banks, and the recent establishment of the coral reefs upon them. His theory is that coral growth was checked or stopped by the chilling of the tropical seas during Glacial times; that as the temperature rose the coral polyps started active growth, while the sea surface was being gradually raised by the melting of the polar ice-sheets. Prof. Daly assumes that the ice-sheets of Europe, America, and the Antarctic all reached their maxima at the same time; and he calculates that the retention of this water on land would lower sea-level by from 27 to 33 fathoms, while the movement of sea water into the polar regions by the lateral attraction of the ice caps lowered the tropical seas another five fathoms. When the sea was thus lowered wave action planed down the great tropical banks and shelves which now support the coral reefs. One of the longest sections of the memoir discusses the depths of coral lagoons, and claims (p. 194) that "neither maximum nor general depths in atoll and barrier-reef lagoons of larger size should so nearly agree if subsidence has been the essential control in forming coral reefs."

The evenness of the lagoon floors may be due to the distribution of sediment by wave action; for the evidence collected by many authorities, such as Nansen and Stanley Gardiner, has shown that the influence of waves extends far deeper than the limit formerly accepted. The fact that no such great thickness of coral limestone as is assumed by Darwin's theory has ever been conclusively established cannot be lightly set aside; and Prof. Daly makes the novel suggestion that the formation of coral reefs may have been stopped by excessive heat as well as by cold. He remarks that when Grinnell Land had a January temperature 50° warmer than it has now, the growth of corals in the tropics was probably inhibited owing to the lowering of their vitality by excessive heat.

Prof. Daly has, therefore, adopted the bank theory of coral reefs, which, as he remarks, was advocated by Tyerman and Bennett in 1832, and in later times by Wharton and Agassiz. The part of Sir John Murray's theory which explained the depth of lagoons by solution is summarily dismissed. That Prof. Daly's explanation is correct for some coral islands may be at once admitted. Thus the evidence from the Maldives and Laccadives, which Prof. Daly clearly states, long ago led supporters of the Darwinian theory to regard those reefs as a coral crust upon a submerged ridge parallel to the Western Ghats. Sir William Wharton originally proposed that one of these islands should be selected for the boring test, but he withdrew this recommendation when it was pointed out to him at the British Association Committee on the subject that these islands would not be regarded as a satisfactory test; so he withdrew his proposal, and at the next meeting recommended Funafuti, which was afterwards selected for the famous boring. Its evidence, however, Prof. Daly rejects on the ground that the bore passed into coral talus, and that "the actual site of the borings was unwisely chosen" (p. 247); but taking all the circumstances into account, the site on Funafuti was probably the best available.

Glaciation has been summoned to relieve geologists from many difficulties, and in spite of the ingenuity of Prof. Daly's arguments, the Darwinian theory may still survive this appeal to Glacial influences. The fundamental assumption that all the Glacial ice-sheets reached their greatest size simultaneously seems opposed to the current trend of opinion. The Glacial period was obviously one of widespread earth movement; the subsidence of Scandinavia, the British Isles, and northern America during their glaciation would have tended to lower the sea-level; but these movements and the amount of water used in the formation of land ice might easily have been masked by uplifts under the tropical oceans.

One objection to the view that the coral reefs have grown upward to keep pace with a rise of sea-level has generally been regarded as fatal; for any such movements should have affected the whole of the tropical seas and should have been uniform throughout them. But vast lengths of coast show no sign of any such rise of sea-level. In the coral seas themselves some districts have raised reefs, while elsewhere the coasts present the features characteristic of subsidence. This fact was shown by Darwin, and has been confirmed by the detailed work of Alexander Agassiz. The grouping of coral reefs according to size and form is also evidence that the coral seas have been affected by differential movements of the sea floor. Dana showed that the coral islands are so grouped as to indicate rapid subsidence along certain lines, while adjacent areas remained stationary. Such facts of distribution appear irreconcilable with the Glacial control theory.

J. W. G.

[1] "The Glacial-Control Theory of Coral Reefs." By R. A. Daly. Proc. Amer. Acad Arts Sci, Vol. li. No. 4, 1915. pp. 157–251.

ILLUSIONS OF THE UPPER AIR.[1]

A REVIEW OF PROGRESS IN METEOROLOGICAL THEORY IN ENGLAND SINCE 1866.

The Study of Cyclones and Anticyclones.

IN 1866, a year after Admiral FitzRoy's death, the Royal Society undertook, by means of the new Meteorological Office, to establish seven other observatories in various parts of the country, equipped just like the Kew Observatory at Richmond, and to use the automatic records in explanation of the weather as set out in the daily maps. The explanation of the winds and the interest of the sailor were the justification of the public expenditure.

Meteorologists knew about cyclones from Piddington in 1848 and about anticyclones from Galton in 1863; from that time onwards until the end of the century the study of cyclones and anticyclones was the dominant idea of dynamical meteorology.

It was mainly conducted by observations at the earth's surface; and necessarily so. In 1852 Welsh, the superintendent of Kew Observatory, had made four sets of excellent observations of the upper air in

[1] From a discourse delivered at the Royal Institution on Friday, March 10, by Sir Napier Shaw, F.R.S.

balloons, and Glaisher had followed them up by a large number of ascents for the British Association, which reached their climax in the famous ascent with Coxwell in 1862. They added a good deal to our knowledge but very little to our ideas. They told us that the atmosphere showed continual decrease of temperature with height, and that surprised nobody; it was a natural incident in the gradual transition from the temperature of the surface of the earth to the absolute zero of space. "The nicely calculated less or more" was not of vital importance. Cyclones and anticyclones obviously belonged to the upper air, the regions where clouds are formed and dissipated, where rain and snow and hail are produced, but balloon ascents told us little about them beyond confirming the surmise that there are great ascending currents associated with certain forms of cloud.

The only real information to be got about the atmosphere in upper regions was that contained in observations of pressure at the surface, which is the cumulative result of the whole thickness of the atmosphere, and the amount of rain, hail, or snow which falls from above. There were also observations of the forms of cloud and their motion, and, if we please, of their position. The rest is necessarily speculation, so that out of these observations meteorologists were obliged to imagine for themselves what cyclones and anticyclones are, how far up they extend, how they are produced and maintained, what kind of air they are made of, and so on.

Observations of the Upper Air.

Speculation can do a great deal with the atmosphere. It goes beyond the reach of our balloons, and tells us of the substitution of hydrogen and the rarer gases for oxygen and nitrogen in the region of the meteor and the solar electron. But from the year 1896 onwards there has been a systematic collection of facts about the upper air by using kites to carry instruments up to heights of 3 kilometres, or occasionally more; ballons-sondes which carry instruments up to heights of 35 kilometres (20 miles or more); and pilot balloons which give the direction and velocity of the wind at various levels up to 10 kilometres, sometimes more.

Comparison of Fact with Speculation.

This investigation has given us a wealth of information about the upper air. The principal result is the division of the atmosphere into two layers: a lower layer about 10 kilometres thick, the troposphere, the region of convection; and an upper layer, the stratosphere, in which there is no convection. We can use the information to test some of the generally accepted ideas about cyclones and anticyclones by comparing the results of speculation with the new facts. Many of the pictures which we imagined now appear to have been illusions. Those of us, for example, who thought that because the air was warmed from the bottom, the upper part would be free from sudden changes of temperature such as we get at the surface were rapidly and rudely disappointed. Simplicity is not apparently the characteristic of the upper air.

The Convection Theory of Cyclones and Anticyclones.

Before giving you other examples, let me quote the description by which Galton introduced the name "anticyclone," because the mental picture of the structure of cyclones and anticyclones which has guided the thoughts of the majority of meteorologists has been formed by the gradual elaboration of the ideas contained in that description:—

"Most meteorologists are agreed that a circumscribed area of barometric depression is usually a locus of light ascending currents, and therefore of an indraught of surface winds which create a retrograde whirl (in our hemisphere)."

"Conversely, we ought to admit that a similar area of barometric elevation is usually a locus of dense descending currents, and therefore of a dispersion of a cold, dry atmosphere, plunging from the higher regions upon the surface of the earth, which, flowing away radially on all sides, becomes at length imbued with a lateral motion due to the above-mentioned cause, though acting in a different manner and in opposite directions" (Proc. Roy. Soc., vol. xii., 1862–1863, p. 385).

Out of that there gradually grew the conception, on the one hand, of the central area of a cyclone on the map as a centre of centripetal motion, a focus of attraction for the surrounding air, and of the general area of the cyclone as a region of ascending warm air producing rain or snow; round the central region the air moves inward with a counter-clockwise motion in spiral curves. On the other hand, the conception of the central area of an anticyclone is of a centre of centrifugal motion, a region of repulsion; the general area of an anticyclone is a region of descending cold air moving with a clockwise motion spirally outwards. The fundamental dynamical idea is that of air driven like gas along a pipe from high pressure to low pressure, retarded by the friction of the surface, and diverted from its direct object by the rotation of the earth.

For future reference, let us separate the three elements of this picture and keep them distinct. First, the *circulation,* counter-clockwise in a cyclone, clockwise in an anticyclone. Second, the *convergence* across the circulation from high to low. Third, the *convection,* or vertical motion, which appears as ascending air in the cyclone and descending air in the anticyclone.

According to the conception which developed on the lines of Galton's description, and found ready acceptance, the circulation is incidental to the convergence; the convergence is universal, the convection general.

It is another example of the *facilis descensus Averni.* The very simple piecing together of the three parts makes it almost obvious that the third element, the convection, is the effective cause of the whole dynamical process; it is natural to regard convection as the ascent of warm air in a relatively cold environment, causing low pressure on account of the relatively high temperature of the ascending air; and high pressure as the natural corollary of cold descending air. The convergence, or motion across the isobars, is the primary result of the distribution of pressure, and the circulation is merely the deviation from the straight path caused by the rotation of the earth. The theory is quite simple and quite self-contained, and it has this great advantage: that the cause which it assigns for the cyclone, namely, the convection of warmed air, has always been regarded as the cause of winds; it has been accepted as explaining land- and sea-breezes, the trade winds and the monsoons; and if it is also accepted as explaining the cyclone and anticyclone, which are the modern meteorological names for the diverse winds of the temperate latitudes, we can see in the idea a beautiful unity in meteorological theory. The origin of all the winds is thereby assigned directly to what we know must be their ultimate cause, namely, the warming of the lowest layers of the air by the warmed surface of sea or land. If we doubt its efficiency in one case, there seems no good reason for holding to it in the others.

It seems a pity that an illusion which apparently does such good service should be shattered; but it cannot face the facts of the upper air.

You will notice that the whole matter depends upon

the idea of the low pressure in the warm ascending air of the cyclone as the driving force, whatever be the area covered by the circulation. The observations of the upper air have made us familiar with certain facts about the height of the atmosphere that make such an idea too improbable. The convective atmosphere is only about 10 kilometres thick. The region in which convection can operate is therefore a thin skin represented by a centimetre in the case of a map on the millionth scale, on which 1000 miles is about 6 ft. in length. A cyclone is often regarded as a towering structure which may produce curious effects by tilting its axis, but that is clearly illusory; the idea that descending air over northern France is operating in conjunction with rising air over Iceland to produce a flow of air along the line joining them is an unproductive way of representing the facts.

The idea of the ordinary cyclones and anticyclones in our latitudes as foci of centripetal and centrifugal motion is an illusion. In all ordinary cases of cyclone the convergence of the paths of air towards the centre is itself an illusion, because the motion of the cyclone makes it miss its apparent aim, and we get in actual fact paradoxical cases of air which, always seeking a place of lower pressure, yet makes its way to a place of higher pressure, because the pressure has been raised over its path; and though it always seeks the centre, in reality it goes further away from it. If it wanted to reach it, it was a mistake to aim at it; if it wanted to get near, it should have aimed to get away. There certainly is convergence and convection, but it is local and not general over the cyclone. The idea which is conveyed by convergence in spiral paths to the centre of a moving cyclone is an illusion. It did not even require observation of the upper air to tell us that.[2]

Take the time required for the operating forces to produce any such wind velocities as we find in actual experience. In one hour an ordinary pressure-difference would produce a velocity of 1000 metres per second if it were free to act. The time required to generate a velocity of, say, 10 metres per second is infinitesimal compared with the time during which we see the forces in operation; these last for hours, or even days, while a minute would suffice for the production of all the velocities exhibited; the motion of the air which we register on anemometers is not accelerating motion but uniform motion, except for the effect of turbulence and local convection; so we must picture to ourselves the air of cyclones as being under the operation of balanced forces, not unbalanced forces. I wish to suggest that the idea of air being accelerated by the forces we see on the map is another illusion so far as the upper air is concerned.

The ostensible reason for supposing that the distribution of pressure created by convection is pushing air from high to low is due to the fact that the charted winds show the air at the surface crossing the isobars from high to low; the observations with kites and pilot balloons suggest that the effect is peculiar to the surface. If the driving force from high to low were the operative force which produces the wind of a cyclonic depression, we should expect to find its operation more strongly marked as we get higher up, because the friction of the surface would not interfere with it; but the fact is quite otherwise. The movement across isobars becomes less and less marked as we ascend. It is much less at Pendennis Castle than it is at Falmouth Observatory, a mile away. We cannot be sure that it exists at all at 1500 ft., because we cannot draw the isobars at that level with the necessary accuracy; the consensus of our observations goes to show that there is no real evidence of convergence at that level. There the centrifugal force of the air travelling over the moving earth, combined with the centrifugal force due to the curvature of the air's path, is sufficient to balance the force due to pressure, and there is no component of motion towards the centre.[3]

What happens nearer the surface is that the friction of the surface converts part of the energy of the motion of the wind into eddy motion and the air does not move fast enough on the right path to keep up the balance. Consequently, it drifts inwards as a pendulum does when its motion is retarded, but the lower air cannot hold back the air far above it; the effect of viscosity in that direction was shown by Helmholtz to be negligible. The effect of the eddy motion is very limited in height.

Observations in the Upper Air in Relation to the Convection Theory.

But the greatest blow to the illusion that I have portrayed comes directly from the observations of the upper air; the convection theory requires that the air of the cyclone should be warmer than that of the anticyclone, but, as a matter of fact, the new observations show that the opposite is the case.

In a paper published by the Royal Society, Mr. W. H. Dines[4] gave the mean values of the observations of temperature in the upper air of this country arranged according to the pressure at the ground. From his results the following table has been compiled:—

Table of Average Values of the Pressure, Temperature, and Density of Air in High and Low Pressure.

Height		High pressure			Low pressure		
		Pressure	Temp.	Density	Density	Temp.	Pressure
1000-ft.	k.	mb.	A	g/m^3	g/m^3	A	mb.
32·809	10	273	226	421	382	225	247
29·528	9	317	233	474	444	226	288
26·247	8	366	240	531	514	227	335
22·966	7	422	247	595	583	232	388
19·685	6	483	254	662	652	240	449
16·406	5	552	261	736	724	248	516
13·124	4	628	267	818	807	255	591
9·843	3	713	272	911	893	263	675
6·562	2	807	277	1012	992	269	767
3·281	1	913	279	1137	1100	275	870
0	0	1031	282	1270	1226	279	984

The figures show that a pressure-difference of 26mb. exists at the level of 10 kilometres where convection has ceased to exist. The difference is accentuated to the extent of 21mb. as the surface is reached by the existence of the high pressure transmitted from above, in spite of the relative coldness of the air at the lower pressure. The diagram included in Mr. Dines's paper showed that there is a remarkable change at the top of the troposphere. Above the level for which values are given in the table, *the high is colder than the low, reversing the state of things in the troposphere.*

We cannot resist the conclusion that the pressure-differences of cyclone and anticyclone are not local surface effects at all; we must seek their origin in the upper air where there is no convection. They are little affected by the lower stratum of 9 kilometres, which, roughly, marks the range of the effect of heating at the surface.

The idea of warm air in the lower layers causing the low pressures which are recorded on our barometers is therefore an illusion.

Thus it will be seen that the observations of the

[2] See "Life-history of Surface Air-currents." By W. N. Shaw and R. G. K. Lempfert. M.O. publication No. 174.

[3] See the four reports on wind structure to the Advisory Committee for Aeronautics by W. N. Shaw and J. S. Dines, also "Barometric Gradient and Wind Force," by Ernest Gold. M.O. Publication, No. 190.

[4] See M.O. Publication No. 210b. Geophysical Memoirs No. 2.

upper air have proved that all the vital parts of the facile description which was the accepted theory of cyclones and anticyclones are quite illusory. What it took for guidance in forming a picture of the structure was the accidental character of motion near the ground. We now feel that the motion of air in the lowest kilometre had better be disregarded, or, better still, be handed over to students of turbulent motion, while we as meteorologists consider the normal state of the atmosphere as motion under balanced forces. Instead of a natural flow from high pressure to low pressure, we have a natural flow without any change of pressure; the motion of a heavenly body round its sun is taken as the type for the air instead of the motion of a falling stone.

While we are considering illusions, let me add another example depending upon what was at one time, and possibly is still, a commonplace of physical teaching in regard to the relation of barometric changes to weather.

It is this: moist air is lighter, bulk for bulk, than dry air, and consequently pressure is low where the air is moist. That is why a low barometer is indicative of rain; the moist air causes the low pressure. This is not true to fact. Mr. Dines has recently examined the correlation between the humidity of the troposphere and the pressure at the surface. The coefficient is quite insignificant; there is no relation between moist air and low pressure on the map.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is announced in the issue of *Science* for March 31 that the wills of the late Edith and Walter Scull, niece and nephew of Mr. David Scull, for many years a manager of Haverford College, give 20,000*l.* to the college.

A meeting convened by the Committee on the Neglect of Science will be held on Wednesday, May 3, at 3 p.m., in the rooms of the Linnean Society, Burlington House. Lord Rayleigh, O.M., will take the chair. A series of resolutions will be submitted to the meeting. Among those who have written in support of the objects of the meeting (many of whom will speak) are:—The Duke of Bedford, Lord Montagu of Beaulieu, the Lord Chief Justice, the Right Hon. Arthur Acland, Mr. Stanley Leathes (Civil Service Commissioner), the master of University College, Oxford, the rector of Exeter College, the master of Christ's, the headmaster of Westminster, the dean of Christ Church, Sir Harry Johnston, Sir Edward Schäfer, Sir William Crookes, Sir William Osler, Sir Ronald Ross, Sir Ray Lankester, Sir William Tilden, Sir Hugh Bell, Sir Robert Hadfield, Dr. Martin Forster, the headmaster of Sherborne, Mr. H. G. Wells, Sir Owen Seaman, and the Poet Laureate, as well as many other leaders in science, education, and industry. Those desiring invitations to the meeting should apply to the Committee on Neglect of Science, 28 Victoria Street, S.W.

We learn from the issue of *Science* for March 21 that Mr. J. D. Rockefeller, junior, has been re-elected president, and Mr. J. G. Greene secretary, of the Rockefeller Foundation. The capital fund of the Foundation on January 1, 1915, was 20,009,600*l.* Grants amounting to 240,000*l.* not hitherto announced have recently been made by the Foundation. To the Rockefeller Institute for Medical Research 200,000*l.* is given for additional endowment needed in connection with the Department of Animal Pathology; and among other grants, the China Medical Board receives 25,000*l.* for the promotion of medical teaching in China. From the same source interesting particulars are forthcoming of the work of the General Education Board founded by Mr. J. D. Rockefeller to promote education within the United States. Since its inauguration and up to June 30 last the Board had made grants amounting to 3,372,400*l.* The value of the Board's resources is 6,791,800*l.*, and the gross income for 1915 was 446,000*l.* approximately. Among the grants made up to the date mentioned, we notice: for the endowment of universities and colleges, 2,334,500*l.*; for the current expenses of colleges and schools, 31,200*l.*; for salaries of professors of secondary education, 55,100*l.*; and for farmers' co-operative demonstration work, 157,200*l.*

The approaching retirement of Dr. Lyttelton, the headmaster of Eton, has led to the suggestion that the governors of the college should appoint as his successor a representative of modern scientific learning instead of a classical divine. The usual objections have been raised to such a course, and the usual unenlightened opinions have been expressed as to the association of scientific education with German barbarity. It would be just as illogical to suggest that the war and its instruments of destruction were due to Christian doctrine as it is to assert that science is responsible for them. Science is concerned with the discovery of new phenomena, new forces, new relationships; and men may use them for good or ill—to ease pain and suffering, or to maim and destroy. It produces chloroform as well as chlorine, and enables a wireless call to be sent from a sinking ship as well as makes the explosive for the torpedo or mine which destroyed her. The popular conception of a man of science as a being without human compassion may do for the stage or a penny novelette, but it ought not to be too much to expect people who write to the leading newspapers to know better. We are glad to see, therefore, that the *Daily Mail*, in a leading article on April 22, gives strong support to the claims of science in public-school education. It points out that "clever talking has come to be regarded as almost or quite as important as sound and vigorous action. Precisely the same defect appeared in the later Roman Empire when its education degenerated into a mere study of rhetoric and declamation." Whatever defects we possess as a nation—and they have been unmercifully exposed in the present war—are due, not to science, but to its neglect. It is satisfactory to know that this is at last being realised by the public; and we hope it may be taken for a sign that, whether through a new type of headmasters or otherwise, the education of our future politicians, administrators, and manufacturers shall include general scientific knowledge and scientific method as essential constituents.

SOCIETIES AND ACADEMIES.

London.

Zoological Society, April 4.—Dr. A. Smith Woodward, vice-president, in the chair.—G. A. **Boulenger**: The lizards allied to *Lacerta muralis*, with an account of *Lacerta agilis* and *L. Parva*. This paper is the third and last instalment of a revision of the wall-lizards, of which the first two parts were published in the Transactions in 1905 and 1913. The author has endeavoured to depart from the empirical method usually followed in the arrangement of species, by tracing back the various forms of this difficult group to a hypothetical ancestor of which *Lacerta agilis* appears to be the nearest living representative. The characters of lepidosis and coloration on which his views are based are discussed, and detailed descriptions are given of *L. agilis* and its ally, *L. parva*, the latter being

regarded as the connecting-link between the first and fourth of the six sections into which it is proposed to divide the genus Lacerta.—R. **Gurney**: Fresh-water Entomostraca collected by Mr. G. W. Smith in Ceylon in 1907. The collection contained examples of thirty-five species, and one species of Copepoda and two of Ostracoda were described as new, one of the latter belonging to the typically African genus Oncocypris.—Major R. **Meinertzhagen**: The Sitatungas (Limnotragus) of the Sesse Islands. The author found that the Bugalla Island antelopes of this genus seem to be of the same race as the mainland form, *Limnotragus spekei*, but that the Nkose Island form, which he proposed as a new subspecies, differed in the shortness of its hoofs and other characters.

Geological Society, April 5.—Dr. A. Harker, president, in the chair.—G. W. **Tyrrell**: The picrite-teschenite sill of Lugar (Ayrshire) and its differentiation. This sill is exposed in the gorges of the Bellow and Glenmuir Waters, just above the confluence of these streams to form the Lugar Water. It has a thickness estimated at 140 ft., and is intrusive into sandstones of the Millstone Grit. The contacts consist of contorted basaltic rock passing into teschenite. The upper teschenite becomes richer in analcite downwards, and ends abruptly at a sharp junction with fine-grained theralite. The lower teschenite becomes richer in olivine upwards, but passes rapidly into hornblende-peridotite. The central unit of the sill is a graded mass beginning with theralite at the top and passing gradually into picrite, and finally peridotite, by gradual enrichment in olivine and elimination of felspar, nepheline, and analcite. The average rock of the sill is much more basic than the rock now forming the contacts. Hence the main differentiation cannot have occurred *in situ*. The theory is advanced that the differentiation units were produced by the process of liquation, but that their arrangement within the sill took place under the influence of gravity. The sill is compared with other teschenite-picrite sills in Scotland, those of Ardrossan, Saltcoats, Blackburn, Barnton, and Inchcolm.

Linnean Society, April 6.—Prof. E. B. Poulton, president, in the chair.—Prof. G. C. **Bourne**: A description of five new species of Edwardsia, Quatr., from New Guinea, with an account of the order of succession of the micromesenteries and tentacles in the Edwardsidæ.—Prof. W. J. **Dakin**: A new species of Enteropneusta, from the Abrolhos Islands.

PARIS.

Academy of Sciences, April 10.—M. Camille Jordan in the chair.—G. **Bigourdan**: Some works of Peiresc. Particulars of some observations recorded in a manuscript dated November, 1610, to June, 1612, including work on the satellites of Jupiter, the moon and planets, and the nebula of Orion.—B. **Baillaud** and M. **Pourteau**: The calculation of right ascensions and declinations of stars of the photographic catalogue. The method worked out is illustrated by a numerical example for one star.—Ch. **Lallemand**: A project for the modification of the legal time. An adverse criticism of the daylight saving scheme proposed in France (see p. 183).—Pierre **Duhem**: The general problem of electrodynamics for a system of immovable conducting bodies.—C. **Guichard**: Plane networks which are at once the orthogonal projection af a network O and the orthogonal projection of a network G.—M. **Cerf**: The transformation of partial differential equations.—Paul **Gaubert**: A crystalline modification of sulphur showing spherulites arranged helicoidally.—G. **Lecointre**: The geology of Djebel Ouitita and the neighbourhood of Dar bel Hamri, western Morocco.—Raoul **Blanchard**: The existence of a glacial island at Grenoble. At the junction of the soft rocks of Grésivaudan and the hard rocks of Chartreuse and Vercors such a glacial formation might be expected, and one has been identified by the author near Grenoble.—Henri **Devaux**: The rapid action of saline solutions on living plants; the reversible displacement of a part of the basic substances contained in the plant. A living plant, Elodea, was washed with distilled water and no calcium could be detected in the washings. The plant was then treated with a solution of sodium or potassium chloride (1 in 1000). Calcium was proved in the liquid, which must have been extracted from the plant cells. This decalcifying action is accompanied by fixation by the plant of a portion of the alkaline metal.—G. **André**: The relations which exist between the presence of magnesium in leaves and the function of assimilation. It is known that crude chlorophyll extracted from leaves by alcohol, or light petroleum, always contains magnesium, the latter being left as phosphate on ignition. It has also been shown that magnesium is the only fixed element forming part of the chlorophyll molecule. Experiments were carried out on the leaves of horse chestnut, lilac, and Spanish chestnut, at different stages of growth (April to July), determinations of the phosphorus and magnesium both in the extracted and residual portions of the leaves being made.—Jules **Courtier**: Variations of the peripheral temperature of the body during suggestions of heat and cold. Under suggestion of cold there was an average increase in the peripheral temperature of 0·28°; under suggestion of heat, an average fall of 0·2°. These variations were in the opposite sense to those expected from the normal behaviour of the body under the action of heat and cold. The vasomotor reflexes do not appear to be affected by suggestion.—J. **Havet**: Relations between neurology and vascular apparatus in the Invertebrates.—F. **d'Herelle**: Contribution to the study of immunity. In the case of *Bacillus typhi murium* attempts to prepare an immunising serum have failed. It is now shown that the antiseptics used to kill the organisms in the preparation of the serum were too strong, not only killing the bacillus but profoundly modifying the toxins. It has been found that various volatile essences (mustard, cinnamon, thyme) can kill the bacillus without affecting the toxin, and a vaccine has been prepared on these lines capable of partially immunising mice against the infection.—Maurice **Beaussenat**: Wound of the heart by a shrapnel ball. Cardiotomy and extraction of the projectile from the right ventricle. Cure.

BOOKS RECEIVED.

Agricultural Research Institute, Pusa. Bulletin No. 56. Green-Manuring in India. By A. C. Dobbs. Pp. 55. (Calcutta: Superintendent Government Printing, India.)

Report of the Agricultural Research Institute and College, Pusa (including the Report of the Imperial Cotton Specialist), 1914–15. Pp. iv+119. (Calcutta: Superintendent Government Printing, India.)

Papers and Proceedings of the Royal Society of Tasmania for the Year 1915. Pp. 128+plates x. (Hobart: Royal Society of Tasmania.) 6*s*.

Annual Report of the Board of Scientific Advice for India, for the Year 1914–15. Pp. 191. (Calcutta: Superintendent Government Printing, India.) 1*s*. 6*d*.

Report on the Calcareous Sponges collected by Mr. James Hornell at Okhamandal in Kattiawar in 1905–6 (with two plates). By Prof. A. Dendy. (London: Williams and Norgate.)

Report on the Non-Calcareous Sponges collected by Mr. James Hornell at Okhamandal in Kattiawar in 1905–6 (with four plates). By Prof. A. Dendy. (London: Williams and Norgate.) 4s. net.

Mysore Government Meteorological Department. Report on Rainfall Registration in Mysore for 1914. By N. Venkatesa Iyengar. Pp. xvii+49+plates iii. (Bangalore: The Government Press.)

The Principles of Plant Culture. By the late E. S. Goff. Revised by J. G. Moore and L. R. Jones. Eighth edition. Pp. xxiii+295. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 5s. 6d. net.

Department of the Interior. U.S. Geological Survey. Mineral Resources of the United States. Calendar Year, 1914. Part i., Nos. 3–13. Part ii., Nos. 8–30. (Washington: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. lxv., Nos. 11, 12, 13. (Washington: Smithsonian Institution.)

Department of Commerce. Technologic Papers of the Bureau of Standards. Nos. 59, 62, 63, 68. Scientific Papers of the Bureau of Standards. Nos. 260, 261, 264, 265. (Washington: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. 27 Bulletins. Water Supply Papers. 13 Papers. (Washington: Government Printing Office.)

Field and Laboratory Studies of Soils. By Prof. A. G. McCall. Pp. viii+77. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 2s. 6d. net.

Report of the Secretary of the Smithsonian Institution for the Year ending June 30. Pp. iii+110. (Washington: Government Printing Office.)

Report of the Commissioner of Education for the Year ended June 30, 1914. Vol. i. Pp. xxxviii+810. Vol. ii. Pp. xxv+565. (Washington: Government Printing Office.)

Smithsonian Institution. Bureau of American Ethnology. Bulletin 57. An Introduction to the Study of the Maya Hieroglyphs. By S. G. Morley. Pp. xvi+284. (Washington: Government Printing Office.)

Smithsonian Institution. U.S. National Museum. Bulletin 92. Bibliographic Index of American Ordovician and Silurian Fossils. By R. S. Bassler. Vol. i. Pp. viii+718. Vol. ii. Pp. iv+719–1521. (Washington: Government Printing Office.)

Leland Stanford Junior University Publications. University Series. The Pronoun of Address in English Literature of the Thirteenth Century. By A. G. Kennedy. Pp. 91. The Anoplura and Mallophaga of North American Mammals. By Prof. V. L. Kellogg and G. F. Ferris. Pp. 74+plates viii. (California: Stanford University.)

DIARY OF SOCIETIES.

THURSDAY, April 27.

Royal Society of Arts, at 4.30.—Scientific Agriculture in India: J. MacKenna.

Mathematical Society, at 5.30.—The Green's Function for the Equation $\nabla n^2+k^2n=0$ (II): H. S. Carslaw.—On the Uniformity of Gaseous Density, according to the Kinetic Theory: S. Chapman.—The Nodal Points of a Plane Sextic: J. Hodgkinson.—Some Problems of Combinatory Analysis: P. A. Macmahon.—On the Deduction of Criteria for the Convergence of Fourier's Series from Fejér's Theorem concerning their Summability: S. Pollard.—On the Derivates of a Function: Mrs. G. C. Young.—Note on Functions of Upper and Lower Type: W. H. Young.

FRIDAY, April 28.

Geological Physics Society, at 5.—Presidential Address: Growths in Silica Gel: Prof. Benjamin Moore.

MONDAY, May 1.

Aristotelian Society, at 8.—The Limitation of Pure Reason: Prof. G. Dawes Hicks.

Society of Chemical Industry, at 8.

Medical Society, at 8.30.—Shakespeare and Medicine: Sir St. Clair Thomson.

TUESDAY, May 2.

Royal Institution, at 3.—Indian and Persian Painting: L. Binyon.

WEDNESDAY, May 3.

Society of Public Analysts, at 8.—Salvarsan and Neo-Salvarsan, Excretion and Secretion of: W. H. Willcox and J. Webster.—Microscopical Methods: H. G. Greenish.

Entomologial Society, at 8.

THURSDAY, May 4.

Royal Institution, at 3.—Flints and Flint Implements: Sir Ray Lankester.

Iron and Steel Institute, at 10.30.—Presidential Address. *Papers*: Notes on the Theory of the Corrosion of Steel: L. Aitchison.—Notes on the Relations between the Cutting Efficiencies of Tool Steels and their Brinell or Scleroscope Hardnesses: Prof. J. O. Arnold.—A New Thermo-Electric Method of Studying Allotropic Changes in Iron or other Metals: Dr. C. Benedicks.—Initial Temperature and Critical Cooling Velocities of a Chromium Steel: Dr. C. A. Edwards.—The Influence of Carbon and Manganese upon the Corrosion of Iron and Steel: Sir Robert Hadfield and Dr. J. N. Friend.—Early Experiments on the Recalescence of Iron and Steel: A. Mallock.—A Few Experiments on the Hardness Testing of Mild Steel: W. N. Thomas.—Surface Tension Effects in the Intercrystalline Cement in Metals and the Elastic Limit: F. C. Thompson.

Linnean Society, at 5.—The Origin of the Garden Red Currant: E. A. Bunyard.—The Dispersal of Organisms, as Illustrated by the Floras of Ceylon and New Zealand: Dr. J. C. Willis.—A Study of the Rectal Breathing Apparatus in the Larvæ of the Anisopterid Dragonflies: R. J. Tillyard.—Description of a New Species of Idotea (Isopoda) from the Sea of Marmora: W. E. Collinge.

FRIDAY, May 5.

Royal Institution, at 5.30.—Electrical Methods in Surgical Advance: Sir J. Mackenzie Davidson.

Iron and Steel Institute, at 10.—(See above.)

Geologists' Association, at 7.30.—Field Notes on the Faunal Succession in the Lower Carboniferous Rocks of Westmorland and North Lancashire: Prof. E. J. Garwood.

SATURDAY, May 6.

Royal Institution, at 3.—X-Rays and Crystals: Prof. W. H. Bragg.

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THURSDAY, MAY 4, 1916.

THERMODYNAMIC AND KINETIC THEORIES.

(1) *Statistical Theory of Energy and Matter.* By Dr. T. Wereide. Pp. xvi + 170. (Kristiania: Gyldendalske Boghandel Nordisk Forlag, 1915.) No price.

(2) *Eight Lectures on Theoretical Physics delivered at Columbia University in* 1909. By Dr. Max Planck; translated by Prof. A. P. Wills. Pp. xi + 130. (New York: Columbia University Press, 1915.) Price 1 dollar.

IN the development of modern theoretical physics two lines of inquiry have played an important part. One has been the attempt to deduce reversible physical phenomena from the inequalities of irreversible thermodynamics; the other the endeavour to reconcile irreversible phenomena with the equations of reversible dynamics. Between the two we have arrived at a more or less satisfactory representation of many phenomena of an essentially statical character. Progress has, however, been somewhat retarded since the death of Boltzmann, nor can we forget Lord Kelvin's healthy criticisms and the steadying influence in times gone by of representatives of the old rigorous school of Cambridge philosophy, such as Watson and Burbury.

(1) Dr. Thornstein Wereide's introduction to the statistical theory of energy and matter is calculated to revive interest in these oft-debated problems. The author will scarcely be surprised at our statement that the book does not appear to throw light on any new facts or contain any original work of a fundamental character, but the method of treatment and of exposition is novel in many respects, and the account of Soret's phenomena describes experimental researches the results of which appear to be inconsistent with preconceived hypotheses.

The book is divided into two sections. The first is occupied exclusively with the deduction of the fundamental formulæ of statistical mechanics, and occupies practically the first sixty-four pages, since "Maxwell's distribution of velocities," though placed at the beginning of section ii., really belongs to the first section. The second section describes the applications of the theory to various physical phenomena, including specific heat, equilibrium, phenomena associated with change of state, diffusion, the phase rule, magnetism, radiation, and finally the quantum hypothesis of Planck.

A study of the first section might with advantage be supplemented by reading some of the older classical treatises and papers on the kinetic theory, in which the application of Lagrange's and Hamilton's equations of motion is developed in greater detail. For example, the proof of Lagrange's equations is unsatisfactory, and the discussion in § 9 cannot be regarded as constituting a rigorous *proof* of the stated property that the density of probability of a system in statistical equilibrium is a function of the energy alone. To understand this property thoroughly it is necessary to read the older proofs based on the formulation of the Jacobian determinant of the co-ordinates and momenta of the system.

Irreversibility is postulated in the following argument:—

"Let us suppose that the system at a given moment passes through a number of elements, W, that are not all possible. It is then very improbable that the system will cease frequenting the elements hitherto frequented, and never visit them any more. On the other hand, it is very probable that the system, as time passes, will take up more and more elements into its circuit provided that an entrance into these elements is possible."

This assumed, the author deduces that—

"A system that is left to itself will change in such a manner that the density of probability for a given state will either remain constant or decrease. The density of probability can never increase."

And he goes on further to restate the hypothesis as follows:—

"A system that is left to itself will move in such a manner that the number of configurations either is constant or it increases. The number of configurations can never decrease."

Unfortunately this assumption is the exact opposite of the second law of thermodynamics, which states that in an isolated system the number of configurations which it is possible for a system to assume is always decreasing. In this case the decrease takes place by the gradual wiping out, one by one, of the possible configurations for which the sum of the potential and kinetic energies of visible motions is a maximum.

The quantum hypothesis is, of course, an innovation since the days of the classical treatises on the kinetic theory. What the author of this book says in commenting on this theory is sensible enough, namely, that by means of this hypothesis Planck has explained phenomena that others have failed to explain, and it cannot, therefore, be rejected merely because it fails to account for everything.

Dr. Wereide thinks that the best way of throwing light on this question is by a renewed study of the trustworthiness or otherwise of statistical methods.

Now it so happens that the writer of this review, before abandoning gases in favour of aeroplanes, endeavoured to direct attention to a method of investigation in statistical mechanics under the title of "Energy Accelerations." The essential feature of this method was to study the *second* differential coefficients with respect to the time of the squares and products of the velocities of a statistical dynamical system, these determining accelerations of energy which would not be altered in sign by reversing the motions, just as the second differential coefficients of the co-ordinates determine the accelerations of the masses. Unfortunately this suggestion does not appear to

have been taken up. Yet it *does* lead to conclusions which impose serious limitations on the conditions under which statistical energy equilibrium is possible. It shows that a given distribution of density of the co-ordinates of a system in statistical equilibrium can only possess a definite amount of kinetic energy; that such a state of equilibrium may be stable or unstable; that certain distributions are incompatible with statistical energy equilibrium because they would give a negative value for the squares of the velocity compounds, and in particular that statistical energy equilibrium, such as occurs in the molecules of a gas, is impossible in a system of bodies attracting each other according to the Newtonian law of gravitation. It is quite likely that such an investigation if continued would lead to the deduction of a system the energy of which might have one or more of a series of discrete values, and might not be capable of continuous variation, or again of a system possessing a large number of discontinuities in the amount of energy which it could contain. It is scarcely probable that the amounts of energy would be proportional to the numbers 1, 2, 3, . . ., but we imagine Planck's assumption is partly justified on the grounds of its simplicity.

Where, as in this case, a method of investigation does necessarily lead to definite conclusions it is important that these conclusions should be worked out, as they must have a disturbing effect on preconceived theories.

(2) In 1909 Prof. Max Planck was invited to give a course of eight lectures at the Columbia College, New York, on the present system of theoretical physics. Under the terms of the Ernest Kempton Adams bequest to Columbia University an English translation of these lectures has now been published, drawn up by Prof. A. P. Wills. It will be seen that the date of these lectures is anterior to Planck's enunciation of his quantum hypothesis, which thus forms no part of their contents.

It is no easy task to give a simple and comprehensive account of such a vast subject in eight lectures, but Prof. Planck's exposition is remarkable for its conciseness, lucidity, and comprehensiveness. As a general survey of the subject the ground covered is best indicated by the titles of the lectures, namely, "Reversibility and Irreversibility," "Thermodynamic States of Equilibrium," "The Atomic Theory of Matter." "Equation of State for a Monatomic Gas," "Heat Radiation, Electrodynamic Theory," "Heat Radiation, Statistical Theory," "General Dynamics, Principle of Least Action," and "Principle of Relativity." We may take the last lecture as a good example of the general character of the book.

Starting with the ordinary notions regarding relative motion of Galileo and Newton, the author first refers to Hertz's theory, and then follows a description of the difficulties introduced by Fizeau's and Michelson and Morley's experiments, both of which lead to the belief that the relative velocity of light is independent of the relative velocity of the ether. The author then shows how these difficulties can be reconciled by the introduction of a new system of space and time co-ordinates for moving bodies which will bring the phenomena attributed to the ether into accordance with the conventional dynamics of material bodies.

The book is one which might with advantage be placed in the hands of a candidate for Honours in physics in one of our universities. To read it cannot fail to be of assistance to a student who has to cover a large amount of work in a limited time.

G. H. B.

A CRETACEOUS FLORA.

Catalogue of the Mesozoic Plants in the British Museum (Natural History). The Cretaceous Flora. Part ii., Lower Greensand (Aptian) Plants of Britain. By Dr. Marie C. Stopes. Pp. xxxvi + 360 + xxxii plates. (London: British Museum (Natural History); Longmans, Green and Co., and others, 1915.) Price 21*s*.

THE Cretaceous Flora, part ii., is devoted to the Lower Greensand (Aptian) flora of Britain. Several species have previously been recorded, but hitherto no general account of the flora as a whole has been written. The most important part of the book is that which deals with new species of Gymnosperms. Twenty-seven Conifers are described, for the most part represented by cones or petrified wood, nine Cycadophyta, five Angiosperms, and two Ferns. The introduction includes some interesting observations on climate, a summary of previous work, and remarks on the geological position of the plant-bearing beds. The descriptions are carefully compiled, and the work of other authors receives frank criticism. A helpful summary is given of current views on the diagnostic value of different anatomical features in the identification of Coniferous wood. The wisdom of employing the generic name Podocarpoxylon for specimens which cannot as a rule be assigned with certainty to the Podocarpineæ is questionable; but Dr Stopes has, on the whole, adopted a judicial attitude with regard to the taxonomic value of anatomical characters.

One of the most remarkable types is that for which the new generic name Colymbetes is proposed; the type-specimen consists of a piece of well-preserved wood enclosing a large pith surrounded by a broad perimedullary zone; next to this is a ring of bundles of vertical tracheids, succeeded by a series of concentric cylinders of secondary wood, composed alternately of vertical and horizontal elements. It is believed that the alternate cylinders are the products of a single cambium, which, "for some reason unknown turned at right-angles periodically."

Some new facts are given with regard to *Bennettites Gibsonianus* and other Cycadean plants and a few new types are described. It is suggested that the formation of more than one cylinder of secondary wood may be accepted as a distinguishing feature of certain Cycadean stems referred to Cycadeoidea, the wood of Bennettites being the product of a single cambium. The co

clusion that Buckland's stems from Portland, on which the genus Cycadeoidea was founded, bore no lateral fertile shoots like those characteristic of Bennettites, as defined by Dr. Stopes, is not in accordance with a statement made by Buckland in a memoir which appears to have been overlooked. In 1912 Dr. Stopes published an account of some Angiospermous stems from British Aptian strata, and in the present volume some additional types are described. Impressions which are almost certainly those of Dicotyledonous leaves have been recorded from rocks slightly older than the Lower Greensand, but the specimens described by Dr. Stopes are the oldest known examples of petrified Angiospermous wood. The anatomical characters are carefully analysed and no pains have been spared to compare the fossils with recent forms. As the author points out, the Angiospermous wood so far discovered exhibits no features which can be regarded as primitive, and it is clear that the evolution of the present dominant class had already reached an advanced stage.

Dr. Marie Stopes has successfully accomplished a laborious and difficult piece of work: the well-illustrated volume is a contribution of permanent value to British Palæobotany.

A. C. SEWARD.

A NEW TEXT-BOOK OF OPTICS.

A Treatise on Light. By Dr. R. A. Houstoun. Pp. xi+478. (London: Longmans, Green and Co., 1915.) Price 7s. 6d. net.

RECENT years have witnessed the production of several good treatises on optics in the English language, chief amongst them being Preston's "Theory of Light," Schuster's "Theory of Optics," R. B. Wood's "Physical Optics," Edser's "Light for Students," and J. P. Southall's "Principles and Methods of Geometrical Optics," to say nothing of more special works, such as Trotter's "Illumination." But Dr. R. A. Houstoun's "Treatise on Light," now before us, occupies a place of its own. It will be welcomed as a manual for classes of a more advanced character than those in which optics is taken merely as a part of a general physics course. The study of optics for its own sake, so neglected in most of the universities, would assuredly receive better attention if optics were handled in the spirit of this book, and with as full an insight into recent developments and investigations. It is, indeed, alive with modern information and research; and, as numerous passages reveal, it is written by one to whom optical laboratory work is familiar, and who directs it to bring out useful and important results.

The book is divided into four parts:—(i) geometrical optics; (ii) physical optics; (iii) spectrometry and photometry; and (iv) the mathematical theory of light. Incidentally, the topic of physiological optics is interpolated in part iii. The section on geometrical optics presents an advance in many features over the exposition of that subject in most text-books, its treatment of thick lenses, of lens combinations, and of aberrations being, on the whole, extremely satisfactory. In few points only does the author give the reviewer occasion to grumble. One of these is his awkward convention as to the signs *plus* and *minus*, which do not here signify measurement to the right and left, respectively, from any fixed zero or origin. Another is the inconvenient practice of treating all rays as travelling from the right to the left, instead of the more usual left to right. Nowhere does the author give the definition of the metric unit of power of lenses, the *dioptrie*, though it was adopted internationally in 1875. The only mention of it—and he spells it *diopter*—is in the brief passage on defects of vision. He builds up the theory of thick lenses quite logically from Helmholtz's tangent law. His brief directions as to the measurement of focal lengths on pp. 75 and 76 are very good. Most unfortunately, he uses the Greek letter λ on p. 300, not to denote wave-length, but to signify a coefficient of absorption; and, in defiance of modern practice, he employs the symbol ν, not to denote the anti-dispersion coefficient, but to signify its reciprocal.

On p. 65 all that the author has to say on the residual chromatic aberration known as "secondary spectrum" is that "it can be diminished considerably by using some of the new glasses made in Jena. They appear, however, to offer difficulties in manufacture and to be not very durable." This is scarcely fair to the achievements of Abbe and Schott; for, though their phosphate crown glasses have not proved permanent, their success in producing pairs of crowns and flints that will eliminate secondary dispersion, and in introducing the really valuable novelty of baryta crowns, should be frankly acknowledged. The advantage of using for a lens a glass with a higher index of refraction, as stated on p. 59, diminishes the spherical aberration considerably; and the baryta crowns give precisely this advantage over the other kinds, while requiring relatively less compensation by means of correcting lenses of flint. The author's remarks on the resolving powers of microscopes, telescopes, spectroscopes, and diffraction gratings are distinctly good. It is a curious point that the ordinary method of describing the working aperture of a lens, so familiar to photographers, as a fraction of the focal length, is only mentioned in this work in connection with the Féry spectrograph and the Rowland grating. Another curiosity in arrangement is the inclusion of the subject of persistence of vision in the section headed "Optical Lantern."

Amongst the outstanding excellences of the work we may praise the chapters that deal with interferometers and spectrographs. The two chapters on spectroscopy—the earlier and later spectroscopic work being separated—are very good. The author seems to labour under the erroneous impression, however, that Newton used only a circular aperture and not a slit. There is a cryptic sentence on p. 238, that the dispersion, as specified by $d\theta/d\lambda$, "is easily found experimentally to

be a minimum at minimum deviation, for if we turn through minimum deviation the spectrum is shortest there." But on the ordinary definition of the dispersion this is far from true. Perhaps the author's definition of dispersion is to be preferred. The author alleges, on p. 252, that it is difficult to show in the laboratory the reversal of the sodium lines. If he will adopt the following plan he will, on the contrary, find it very easy, even as a lecture demonstration. Use a hand-feed arc lamp. Let the lower carbon be hollowed out so as to form a sort of small crucible; but let a slight V-notch be cut in its rim on the side towards the projecting lens-system of the lantern. Let the upper carbon be thin and pointed and set to strike the arc by contact with the rim on the opposite side. Put a pellet of sodium in the "crucible," and then move the top carbon down and up several times so as to strike the arc repeatedly. A continuous spectrum is evoked, accompanied usually by bright lines, including the D-line; but the D-line at once changes to a black line, since the light has to pass through the mass of sodium vapour which is slowly pouring over the V-notch.

In the chapter on the later spectroscopy Rowland's photographic charts, Balmer's series, the work of Kayser and Runge, and that of Stark, Zeeman, and Michelson, are admirably described and summarised. The chapter on infra-red and X-rays is also admirable, but the early work of Crookes, which led up to the radiometer, is ignored. Chapter xx., on lamps and illumination, is less satisfying. Surely the estimate of 200,000 candles per square inch for the intrinsic brilliancy of the crater of an arc lamp is too high.

The fourth part, the mathematical theory of light, is a very able and very welcome feature of the work, though it is not all easy reading. It deals with the propagation of single pulses and groups of waves; the modern notion of the true function of prisms, not as sorters-out of hypothetically pre-existing trains of periodic waves, but as the manufacturers of these trains out of miscellaneous and utterly irregular impulses; the electromagnetic theory of light; the experiments of Hertz; the problems of reflexion and refraction; the theory of dispersion; the theory of radiation; and the pressure of light. A pregnant chapter on the relative motion of matter and ether, in which the celebrated paradoxical experiment of Michelson and Morley forms the pivot of the argument, brings the book to the close with the remark that the Michelson-Morley experiment is a somewhat narrow basis on which to rear such a structure as the "relativity" doctrine of Einstein. It is indeed.

To many of the chapters Dr. Houstoun has appended series of questions and problems. These are excellent, being real problems of optics, and not, as in the majority of college text-books, mere mathematical puzzles. There is a reality and freshness about them that is wholly commendable.

The tables included at the end of the book are all too short. But they are satisfactory compared with the index. One looks in vain for many things. The index contains no reference to aperture, Ångstrom's unit, crossed prisms, diffuse reflexion, index of refraction, luminosity, luminescence, persistence of vision, power of a lens, refraction, or selective radiation; and the inquirer who wants to know the significance of μ or of $\mu\mu$ will vainly hunt for the footnote on p. 243 or that on p. 298, where these mysteries are revealed. In an important text-book such as this an index ought not to be left to a compiler who does not grasp what are the good things that must not be left unindexed. One misses even any reference to some of the best and most instructive things in the book, the original researches of the author himself, which are to be found on pp. 299, 324 and 350. The publishers ought at once to scrap the index without waiting for the second edition which is certain to be called for at no distant time.

S. P. T.

OUR BOOKSHELF.

The Moon: Considered as a Planet, a World, and a Satellite. By J. Nasmyth and J. Carpenter. Cheap edition. Pp. xix+315. (London: J. Murray, 1916.) Price 2*s*. 6*d*. net.

IT is a pleasure to direct attention to the issue, at an extraordinarily low price, of a complete edition of Nasmyth and Carpenter's classical work on lunar physiography. Accustomed as we are o[f] late years to cheap editions, this reprint appears to us to present really exceptional value. The work first appeared forty-two years ago, and was reviewed in NATURE of March 12, 1874. That th[e] appreciative tenor of that review was entirel[y] deserved is sufficiently evidenced by the fact tha[t] four editions have been issued. Nevertheless, i[t] may not be out of place to quote a fairly recen[t] French endorsement:—

"Au point de vue pittoresque, aucune repré[-]sentation précédente ne pouvait donner une mei[l-]leure idée de ce que l'on voit au télescope que le[s] reliefs de Nasmyth. Les photographies actuelle[s] sont plus exactes, mais elles sont loin d'atteindr[e] le charme des planches de cet ouvrage qu'on n[e] se lasse point d'examiner."

It so happens that the review copy of the fir[st] edition has somewhat often been in the hands [of] the present writer, and as the illustrations a[re] such an important feature, it is satisfactory to b[e] able to state that the reproductions in this late[r] edition compare favourably with the original. The text, written when distinction of literary sty[le] could be found even in books of science, can st[ill] be read with profit and with pleasure.

H. E. G.

Graphics and Structural Design. By Prof. H. [D.] Hess. Second Edition. Pp. viii+435. (N[ew] York: J. Wiley and Sons, Inc.; Londo[n:] Chapman and Hall, Ltd., 1915.) Price 12*s*. [6*d*.] net.

THE first edition of this book appeared in 19[1-]. The author was formerly designer and compu[ter] for the Pencoyd Iron Works and the Americ[an]

Bridge Company, and is now a professor in Sibley College, Cornell University, His experience, therefore, leads us to expect that his volume will contain much matter of service to structural draughtsmen, and that the treatment will be suitable for students. The early demand for a second edition is evidence that the author has been successful in his treatment, and this is confirmed by inspection of the text. The book does not pretend to deal with the mechanics of materials —the student is referred to other books for this —and the reader who has studied materials will find his knowledge drawn upon throughout the book in application to a large number of structures. Sufficient is given at every step to enable the student to understand which particular theory is being applied. There are practical examples, fully worked out, of every class of structure discussed, and the formulæ used in practice are explained clearly. A large number of exercises to be worked by students is included.

Although the methods of design are American, the British student and designer of structures will profit considerably by going through this volume. We have read chapters xvii. and xviii. with particular interest; these deal respectively with retaining walls and with bins for holding grain and coal; the latter chapter is exceptionally complete, and, as is usual throughout the book, contains typical examples worked out.

Rambles in the Vaudese Alps. By F. S. Salisbury. Pp. x+154. (London: J. M. Dent and Sons, Ltd., 1916.) Price 2s. 6d. net.

MR. SALISBURY'S book gives a pleasant account of a summer holiday in 1908, spent at Gryon in unambitious excursions among the limestone Alps of the western Oberland. The fine views of such mountains as the Diablerets and the Grand Muveran, in the immediate neighbourhood, and the magnificent gable-end of the Dent du Midi on the other side of the Rhone, as they rise above slopes of green pasture and dark pine-wood, make this an unusually attractive district.

The author writes, not for geologists or botanists, but for lovers of mountain scenery and mountain flowers. As, however, he did not reach Gryon until the beginning of August, he was too late for the blossoms which, some five or six weeks earlier, make the meadows, from three to five thousand feet above sea-level, a carpet of many colours. These, in that month, have given place to less graceful kinds, such as the yellow and purple gentian, the white hellebore (*Veratrum album*), and the monkshood. But his visits to the summits and passes, some three thousand feet above the level of Gryon, were rewarded by such lovers of the mountain air as the *Dryas octopetala* and the alpine aster, the little blue gentians, and even the edelweiss. Some photographs of the flowers, by Mr. Somerville Hastings, add to the interest of the book, and it is one which the tourist who loves to linger rather than to hurry, and desires to learn a little about the plant world of the Alps, will find a useful and attractive companion.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Zeppelin Notes.

As one who happened to be in a region which came in for attention from Zeppelin bombs, I have jotted down some of the points of more immediate interest which stand out from an experience in which everything was rather blurred:—

The bombs could be heard approaching as they rushed through the air. The whistling noise—a little like the tearing of calico or the noise made by a gigantic rocket—became a crescendo shriek of terrific intensity just before the bomb struck the ground and the explosion occurred. In the present instance I estimated the height of the Zeppelin as about 4000 ft., and, neglecting air resistance, this would give the bombs a final velocity of about 500 ft. per second. The actual speed was probably less than this, and is considerably less than the velocity of sound (1100 ft. per sec.), which accounts for the fact that the bombs can be heard before their arrival.

Standing as I was at about 200 yards from where one of the bombs fell, the noise of the actual explosion did not appear to be very loud. The reason is probably to be sought in the almost complete numbing of one's senses. All one could do was to stand stockstill and wait for the next bomb. The feeling was much the same as if one had been given a hard blow between the eyes with a bolster or some relatively soft object. I heard a piece of bomb "zip" past me, and afterwards found it embedded in a balk of timber about two yards from where I was standing. A huge cloud of black smoke arose into the air, reminding one of the photographs of Jack Johnson shells bursting.

The results of an explosive bomb show curious freakishness, especially in enclosed spaces. Evidently "pockets" of high pressure result in various directions, and the destruction is confined to the direction of these pockets. Considerable damage may be caused apparently by the air rushing in to restore the pressure after a high-pressure wave has passed forward. For example, one bomb fell near a small outhouse. The doors were blown bodily inwards—mostly owing to the hinges and frames breaking loose—yet the surrounding wall of the house was "started" outwards. One pane of glass in a window-frame disappeared, while an adjacent pane similarly situated was undamaged. The lid of a kettle was deftly blown off by the air wave going down the spout, the kettle being undamaged.

The bombs fell in soft marshy ground, and the effects of the explosion were very local. Apart from flying missiles, the danger zone did not appear to exceed 25 yards or so. Windows, about 15 yards away, on the side of an outhouse remote from the explosion were quite intact.

Pieces of one of the explosive bombs perforated some steel plates standing vertically about 10 yards away. The edges of the holes were rounded, and showed undoubted signs of fusion, due no doubt to the speed of the shearing. In one instance a piece of the phosphor-bronze casing of the bomb penetrated a steel plate more than 1 in. thick.

The holes caused in the soft clayey ground by the explosive bombs were approximately conical, some 10 ft. across, and about 4 ft. deep.

The incendiary bombs could be heard coming with

a whizzing noise, rather like the explosive bombs. They blazed furiously, and lit up the whole neighbourhood. We had, however, no great difficulty in extinguishing one with a hand fire-extinguisher. They contain, I imagine, tar, petrol, and much besides.

The rapid succession of the bombs and the spacing apart of the holes showed that the Zeppelin was travelling at high speed at the time, due no doubt to the activity of the anti-aircraft guns. She could not have hoped to hit any specific object, and, indeed, ludicrously failed to hit anything but clay.

The control of the airship was considerable. She was very nimble in endeavouring to evade the searchlights, which, however, had no difficulty whatever in keeping her in the beam.

OBSERVER.

THE KIMMERIDGE OIL-SHALES.

THE rapid extension of the use of oil fuel in the Navy, coupled with the desirability, for obvious reasons, of securing adequate supplies from home sources, has led to renewed attention being given to the large and easily accessible deposits of oil-bearing shales which have long been known to occur in the vicinity of Kimmeridge, in Dorsetshire, and there is reason to believe that the question of their immediate utilisation has already been urgently pressed upon the notice of the Admiralty.

Assuming that oil of a satisfactory character can be obtained from these shales, there are several considerations which would seem to point to Kimmeridge itself, or some place in its near vicinity, as a suitable spot at which to establish workings, not the least important of which is its proximity to Portland, one of our leading naval stations. Kimmeridge is close to the coast, and although somewhat exposed to gales from the south-west, might be made sufficiently secure as a harbour to enable shipments of the shale to be made to Castletown, or other convenient locality, if it were found impracticable to distil the shale near the place where it is raised. And in any case, should difficulties be found in making the Kimmeridge haven sufficiently safe for vessels to lie at anchor or alongside the jetty that would have to be constructed, Portland Harbour of Refuge is only a few miles distant, and can be entered at any time of tide, and in any weather.

Many attempts have been made to work the Kimmeridge shales for oil, but hitherto without much success, owing largely to the character of the product and the difficulty of rectifying it into a marketable product as naphtha and illuminating oil. But the nature of oil fuel is wholly dissimilar from that of ordinary burning oil, and its chemical and physical characters are quite different. Nor is the same standard of quality as regards colour, freedom from sulphur, etc., needed in a fuel oil as in an oil intended for illuminating purposes. Hence it is possible that there may be an outlet for the Kimmeridge oil that has hitherto been denied it.

The Kimmeridge shales have long received the attention of geologists, and their extent and distribution have been carefully traced. The outcrop along the Dorsetshire coast begins a mile or two to the west of St. Alban's Head, and, as see[n] from the sea, forms a very striking natural featu[re] as Kimmeridge is approached. The deposit[s] extend to very considerable distances, and are [of] unknown depth. To the west they are found [at] Portland, which, indeed, is known to rest upo[n] them, and they were formerly worked for fuel i[n] the island. They come out here and there alon[g] the West Bay, or in its vicinity, as far as Abbots[bury]. They have been known in times past t[o] ignite spontaneously, probably owing to the hea[t] developed by the rapid oxidation of marcasite or some other form of iron pyrites. They exten[d] to the north of Dorsetshire, and have been trace[d] by borings and by outcrops in a north-easterl[y] direction to Norfolk, and through Lincolnshir[e] to the Humber.

In the neighbourhood of Kimmeridge the shal[e] was long used as fuel, and is still so used to [a] limited extent in the country cottages. In the sixteenth and seventeenth centuries it was worke[d] for alum as at Whitby, and by the same methods the large quantity of pyrites it contains affording the sulphuric acid, whilst other portions serve[d] as fuel for evaporation, etc.

The shale seems to have been first worked fo[r] oil about 1848, when small shipments were sent to Weymouth, where the retorting was done—a fact which was held, although unsuccessfully, to invalidate Young's patent for the manufacture of paraffin oil by destructive distillation at a low temperature. At the famous trial Vice-Chancellor Stuart ruled that "the manufacture of offensively-smelling and unmarketable oils from Kimmeridge shales could not be held to be an anticipation of Young's patent." It is, however, interesting to note that Weymouth was the first place in the United Kingdom at which the distillation of shale for the production of hydrocarbon oils was attempted on a manufacturing scale.

In addition to oils of various grades the shales yield notable quantities of ammonia on distillation, a fact which has an important bearing upo[n] their commercial value.

In a highly interesting and suggestive pape[r] recently read to the Institution of Petroleu[m] Technologists, Mr. W. Hardy Manfield has give[n] a very full account of the Kimmeridge oil-shales their distribution and geological features, and [of] the various attempts which have been made t[o] turn them to account. The communication als[o] gives a description of the methods of winnin[g] oil-shale, of distilling it, and of treating the pro[]ducts, based upon practical experience. Th[e] paper is particularly valuable on account of th[e] author's local knowledge of the Kimmeridg[e] deposits.

The great objection to the use of Kimmerid[ge] oil is due to the large quantity of sulphur it co[n]tains, which it has hitherto been practically im[]possible to remove to a sufficient extent to mal[ke] the oil marketable. All attempts at purificatio[n] by the methods of treatment ordinarily used—mainly acid and alkali—are of little value. T[]

fact is nothing is really known concerning the nature of the combination in which the sulphur is present. It is evidently very firmly held, for the compound or compounds will stand the most drastic treatment without being broken down. There is here a fine field of investigation for any chemist who will grapple with the problem. What seems to be wanted in the first place is that these sulphur compounds should be satisfactorily isolated, and their properties studied. When we know more about them it may be possible to learn how to deal with them. We would invite attention to what is really a very promising subject for inquiry. There can be little doubt that it would yield to systematic attack by modern experimental methods familiar to organic chemists, and there are the possibilities of great material benefits to him who will satisfactorily solve the problem.

THE WASTAGE OF COAL.

THE Committee for the Investigation of Atmospheric Pollution has just issued its first report, from which it is evident that it has carried out its self-appointed task in a thoroughly scientific and (if the terms are not incompatible) business-like manner. Nineteen towns have undertaken a periodical analysis of the impurities carried down by rain falling on different stations, and also of the constituents of the dust deposited on a specially designed dust gauge of standard dimensions. These results have been tabulated in metric tons per sq. kilo. per month under the headings of insoluble matter (including tar, non-tarry carbonaceous matter, ash), soluble matter (including volatile, combustible, and non-volatile solids), and sulphuric acid (as sulphate), chlorine (as chloride), and ammonia.

The summary at the end of the report gives a comparative survey of the data from the different localities. These data naturally vary with the nature of the environment, whether industrial, residential, or rural. With the exception of some rather interesting and curious local variations, the general results are such as might be anticipated. In industrial centres, such as Oldham, Bolton, and the Ancoats district of Manchester, the impurities reach a maximum, and yield 25 tons or more of total solids per month, and proportionate quantities of sulphuric acid (3–5 tons), chlorine (0·9–1·5 tons), and ammonia (0·15–0·25 ton), whilst Malvern, situated in an agricultural area, shows a minimum record of less than 5 tons of total solids per month, the monthly mean being 4·13, with 0·50, 0·24, and 0·02 ton of sulphate, chlorine, and ammonia respectively.

This large amount and wide distribution of atmospheric pollution from burning coal (for the impurities are practically all derived from coal) raises two issues: the one a question of injury to animal and plant life, the other one of economy.

Leaving on one side the health question, and confining our attention to the economic problem, which is a pressing one in these days, we look to our coal supply, not only for fuel, but for the raw material for explosives, dyes, synthetic drugs, ferrocyanides, ammonium salts, and, to some extent, sulphuric acid, in every one of which there is a more or less serious shortage. Yet of the two hundred million tons of coal consumed annually, less than forty million tons are burnt economically, that is to say, gasified in gas retorts and by-product coke ovens, whilst the remainder, or 80 per cent., is used, not only as raw fuel in which all the valuable by-products are lost, but through incomplete, and therefore wasteful, combustion contaminate the atmosphere and the soil over an area which may be reckoned in hundreds of square miles.

Is there no way of compassing this absurdly wasteful system of utilising coal? Prof. H. E. Armstrong, in a recent address to the Society of Chemical Industry, suggested that the society should advocate an enactment forbidding the use of raw coal for domestic purposes. We are confident that such an enactment, even if it were made more comprehensive in its scope, would instantly solve the problem of the by-product wastage, and simultaneously clear the atmosphere of smoke without injury or discomfort to home or commercial life.

Faced as we are with the shortage of by-products as well as with the immediate and pressing necessity of restricting expenditure, the subject of fuel economy is one which, along with the wastage on drink, demands more than any other form of economy, on account of the prodigious sums involved, an instant and drastic change in our traditional method of *laissez faire*.

In the circumstances it is somewhat unfortunate that the Local Government Board, which instituted an inquiry into smoke abatement in the spring of 1914, should have suspended its sittings just at a time when the result of its deliberations might have borne some fruit; and it is to be hoped that a similar committee having wider powers may shortly be appointed to deal with, in addition to smoke abatement, the larger question of the wastage of coal.

J. B. C.

NOTES.

THE tercentenary of Shakespeare's death is being commemorated this week, and tributes to his genius are being paid in many other parts of the civilised world. The event may not be regarded as of particular scientific significance, yet to let it pass unnoticed in these columns would be to show a want of pride for the memory of the greatest master of our literature. In the Elizabethan age, the cockatrice, the mermaid, the phœnix, the unicorn, and like legendary creatures were realities to the general public, and as such were referred to in the works of the great dramatist and other contemporary writers. We have, for example, in "The Winter's Tale," the line, "Make me not sighted like the basilisk," and in "The Tempest," "Now I will believe that there are unicorns." Not only was more or less credulity given to the existence of these and other fabulous creatures, but a web of mystic lore encircled the most common and best known of beasts, birds, and fishes. But though Shakespeare gave credence to many of the legends he quoted, especially in regard to the animals and plants of distant lands, he had a greater knowledge of natural

history than many of his contemporaries. An article in the *Times* of May 2 shows that he was familiar with the characteristics and habits of many birds, and the accuracy of his references to them would do credit to a modern field naturalist. The greatness of Shakespeare, however, lies not so much in the fact that he reflected in his works the best knowledge of his time, which is more than can be said of most writers to-day, but that he enriched and defined with thought what most people feel, and perceived in Nature resemblances and meanings which are hidden to the ordinary mind. In these respects, poetry is independent of knowledge, which does not, however, destroy the magic and the mystery upon which the imaginative mind can play, but transfers them to higher planes. For Shakespeare's knowledge and his power to set in vibration every chord of the human spirit, we join this week in reverent admiration with lovers of good literature throughout the Empire.

The special correspondent of the *Times* at Amsterdam reports that the change of the legal time-standard in conformity with the daylight saving scheme came into force in Holland on May 1 without any appreciable disturbance of the daily life of the community. All clocks were put forward one hour at midnight on Sunday; therefore, instead of 1 o'clock, 2 o'clock was struck one hour after midnight. This "summer time" will be used until October 1. It is stated that there has been little opposition to the change except among Frisian farmers and dairymen, who, for practical reasons connected with haymaking and milking, desire exemption from observance of the new time. The *Times* correspondent adds that calendars giving the times of the rising and setting of the sun necessarily require readjustment to the altered time. He does not indicate, however, how this change is to be effected; that is to say, whether the calendars are to show astronomical occurrences, such as times of sunrise, sunset, moonrise, tides, and so on, according to one time-standard in summer and another in winter. In legalising the daylight saving system, Holland has followed Germany and Austria, which introduced it by administrative decree on May 1. A Bill with the same object has been passed by the French Chamber of Deputies with the support of the Government, and is now before the Senate; and Sir Henry Norman has handed in the following notice of motion at the House of Commons:—"That, in view especially of the economy in fuel and its transport that would be effected by shortening the hours of artificial lighting, this House would welcome a measure for the advancement of clock time by one hour during the summer months of this year."

A letter of Sir Lauder Brunton to the *Lancet* of April 3, 1915, anticipates to some extent the recommendations contained in the memorandum on "Industrial Fatigue and its Causes," issued by the Health of Munition Workers' Committee, and described in our issue of April 20 last (p. 162). Sir Lauder Brunton refers to an experiment made many years ago by the late Mr. Lindsay Russell, Surveyor-General of Canada, and Prof. Pearce when surveying the boundary-line between the United States and Canada. From the force of circumstances it was sometimes necessary to work the men for seven days a week, and several weeks at a time. On other occasions, when there was no necessity for such extreme exertion, the men were only worked six days a week, and allowed to rest completely on the seventh day. It was possible to calculate exactly the amount of every man's daily work in foot-pounds. On reckoning it up it was found that the number of foot-pounds done by the men working six days a week was almost the same as when they worked seven days a week. Sir Lauder Brunton expresses the opinion that in all probability if munition workers work at their full capacity for six days it will be better both for them and the work they turn out that they should rest on the seventh.

We are glad to note that the Reale Accademia dei Lincei of Rome is taking up the question of the maintenance of the zoological stations at Naples and Messina, and that the Italian Government is being asked to provide the means for continuing the work of these institutions.

At the ordinary scientific meeting of the Chemical Society, to be held at Burlington House on Thursday, May 18, at 8 p.m., the last of the three lectures arranged for this session will be delivered by Prof. F. Gowland Hopkins, F.R.S., who has chosen as his subject, "Newer Standpoints in the Chemical Study of Nutrition."

Mr. Clifford C. Paterson, a principal assistant in the physics department of the National Physical Laboratory, is to join the Osram-Robertson Lamp Works, Ltd., as director of laboratories for research and technical manufacturing purposes. The arrangement will commence at the conclusion of the war or before that date if possible.

A short account of the career of the late Mr. Erasmus Darwin Leavitt, who died on March 11, appears in *Engineering* for April 28. Mr. Leavitt was a well-known American engineer, and was one of the pioneers who developed the use of high steam pressures in stationary engines in the United States. He was one of the founders of the American Society of Mechanical Engineers, and was elected president in 1883.

The death of Mr. John Tweedy is announced in *Engineering* for April 28. As vice-chairman of Messrs. Swan and Hunter, the well-known Tyne shipbuilders, he was one of the leaders in the design of high-speed merchant craft. One of the notable services which he rendered was connected with the balancing of the engines, and his name will be remembered in connection with the Yarrow-Schlick-Tweedy system of balancing. He was elected president of the North-East Coast Institution of Engineers and Shipbuilders in 1902, and for some time served on Lloyd's technical committee.

The report for the year ending June 30, 1915, of the secretary of the Smithsonian Institution contains some interesting facts as to the amount of money the institution has at its disposal for the assistance of scientific research and exploration and for general administration. Its total permanent fund amounts to 205,920*l*. The income of the institution during the year dealt with was 22,408*l*. With the balance of 6112*l*. on July 1, 1914, the total resources for the year amounted to 28,520*l*. The disbursements for the year amounted to 20,086*l*. The institution was charged by Congress also with the disbursement of grants for scientific work amounting to 121,200*l*.

The late Dr. P. Wharton-Hood, who died at the advanced age of eighty-two, on April 27, rendered an important service to surgery early in his career. His father, Dr. Peter Hood, a well-known physician in London, had attended Mr. Hutton, the famous "bone-setter," through a long and severe illness. In acknowledgment of the father's services, Mr. Hutton imparted to the son all that pertained to the practice of "bone-setting," and what was found to be good in that practice was given by the son to the medical profession in a series of articles contributed to the *Lancet* in 1871. The late Dr. Wharton-Hood and his father, Dr. Peter Hood, were pioneers in the introduction of massage

as a legitimate and effective means of treating sprains and other injuries. The son's best-known work is "The Treatment of Injuries by Friction and Movement," which was published in 1902.

In a circular issued to the fellows of the Chemical Society, the treasurer states that the council has decided to publish portraits of the three past presidents, Sir Henry Roscoe, Dr. Hugo Müller, and Prof. Raphael Meldola, who have died during the past year. The portraits will be suitable for framing or for binding with the Journal, and will be sold at a cost not exceeding 1s. 6d. each to those fellows who apply to the assistant secretary before August 1, 1916. If there is expressed a sufficiently general wish to possess portraits of other past presidents, arrangements will be made to carry this into effect. A complete list of the thirty-four past presidents of the society is given, and fellows are requested, when sending in their applications, to denote on the form provided which portraits they desire to possess.

Astronomical science has lost an energetic worker by the death of Dr. W. F. King, C.M.G., the chief astronomer of the Department of the Interior of Canada, who had done so much to systematise and extend the work of the Dominion Observatory at Ottawa. Born in England, in 1854, he early went to Canada, and was educated at Toronto University, passing out as one of the most brilliant of its alumni. His active scientific career began with the work of the International Boundary Commission, and from his last issued report we find that he was still actively engaged upon geodetic problems. These included the determination of the boundary line through Passamaquoddy Bay, the re-survey of the 49th parallel and that of the 141st meridian. In a new country such delimitations are pressing and important, and Dr. King worked on them with vigour and success. To him also fell the duty of organising the Ottawa Observatory and the settlement of its programme of work. His official position required him to encourage and support many new scientific schemes and institutions that mark the rise and progress of the Dominion. In no department is Dr. King's work better seen and acknowledged than in that of spectroscopy, as carried out in the Dominion Observatory. The observations are of the highest character and interest, and in the large outcome he took an active part. The bold scheme of supplementing the optical equipment of the observatory by the addition of a 60-in. reflector was his conception, and the progress made in its construction is due not a little to his energy and enthusiasm. The excellent seismographic work, embracing a wide network of stations, though under the immediate superintendence of Dr. Klotz, is another evidence of his administrative ability, and the magnetic survey carried out with vigour over a large area similarly displays the extent of his resources and the power of his organisation.

An interesting experiment in the practical application of anthropology is to be made shortly in the United States. One of the great difficulties of the Administration has been the question of the alienation of land of Indian holders. These lands are frequently of value on account of their timber, and their purchase by speculators at absurdly inadequate prices, and the consequent impoverishment of the Indians, have been a scandal, to which Dr. W. K. Moorehead in particular has directed attention on more than one occasion. In Minnesota power to sell their land is vested only in owners of mixed Chippewa descent; the land of the pure-blooded Chippewa is inalienable. Speculators have, however, been successful in getting hold of it, and the Government has had to intervene. As a result, to prove title it has been necessary to show the mixed descent of the vendor. This is a matter of some difficulty, and a prominent anthropologist has been invited to visit the Chippewa with the view of deciding the question of mixed descent in the cases in dispute. The lawyers of both sides have agreed to abide by his verdict. This solution will recall certain recent proceedings in our own courts, but it is to be hoped may lead to a more decisive result.

A valuable article in the current Journal of the Royal Anthropological Institute (vol. xlv.) is that by Mr. R. Grant Brown, on the Taungbyon festival in Burma, illustrating the animistic basis of the Buddhism of the province. It represents the cult of Two Brothers, who are said to have been Mohammedan martyrs. The chief part of the rite is the ceremonial cutting down of two *teinbin*, or coffeewort, trees (*Nauclea cordifolia*) by officiants representing the Two Brothers. These trees are, except in connection with their cult, not otherwise regarded as sacred. The custom raises some interesting questions the origin and meaning of which continue to be obscure. Do the trees, as Sir James Frazer would say, represent the Spirit of Vegetation, slain at the ceremony, and at a later time reborn in the fields? Or, as Mr. Brown seems to prefer, did one of these trees, according to Prof. Ridgeway's speculations, once grow on the grave of the martyrs, and thus came to be held sacred, and its branches were distributed to the people because they were supposed to be impregnated with the spirits of these holy men? Mr. Brown justly remarks that it is not necessary to assume a single origin for any custom, and a custom may be continued for reasons altogether different from those which originated it. It seems to be possible that the Two Brothers were deified on account of the strong feeling of local patriotism because they opposed the tyrannical native dynasty. In any case, it is interesting to note that these Mohammedan brothers were deified among a strictly Buddhist population.

A large portion of the *American Naturalist* for March is accorded to Profs. Stockard and Papanicolaou, to enable them to complete their analysis of the hereditary transmission of degeneracy and deformities by the descendants of alcoholised guinea-pigs, already alluded to in these columns. The authors find that the offspring of alcoholised females have a higher viability than in the case of alcoholised males, from which they conclude that the male germ cell is more affected by alcohol than the ovum. The male offspring of alcoholised females are inferior to their female offspring. The female offspring of alcoholised males show a higher mortality and more deformity than the male offspring, from which they conclude that the female-producing sperms are more modified by treatment than male-producing sperms.

The spring number of *Bird Notes and News*, the organ of the Royal Society for the Protection of Birds, reports that a fresh raid by plume-hunters has been made on the albatrosses of Laysan Island, one of the largest of the U.S.A. bird reserves. The breast feathers only seem to have been taken, and to obtain these between 150,000 and 200,000 birds were slain, their bodies being found lying in heaps all over the island. The majority of the victims were furnished by the white- and the black-footed albatross, and after these the greatest sufferers were frigate birds and the blue-faced booby. This iniquitous traffic in plumes could now be effectually killed if the import of plumage into this country were prohibited. Having regard to the restriction in imports now in force, this item might well be added to the list. The ghastly toll of bird-life demanded by the milliners has long

been a standing disgrace to civilised communities. At the present juncture the Government might well prohibit entirely the importation of all plumage—ostrich feathers and eiderdown only excepted—as a useless and undesirable import, and a wholly indefensible form of extravagance.

In a recent number of the Journal of the College of Agriculture, Tohoku Imperial University, Japan, Mr. Schin Yoschida gives an account of a series of interesting researches. He has investigated the manner in which "milk" is formed in the crops of brooding pigeons. The so-called "milk" is not produced in glands, but by a proliferation and fatty degeneration of the epithelial cells lining the crop. The growth and shedding of the epithelial cells occur only during the brooding season, and affect both male and female birds. Mr. Yoschida has also made further inquiries into the nature of the horny masses (callosities and ergots) found on the legs of horses. He maintains that an examination of their microscopical structure supports the contention that these horny masses represent the hoofs of two of the missing or vestigial digits of the horse. He infers "that the callosity is the nail of the second toe, and the ergot (the horny spur hid by the hair of the fetlock), of the fourth toe."

The first part of the ninth volume of the Journal of the Marine Biological Association contains an account of some biometric investigations carried out in connection with the question of the localisation of the different races of herrings inhabiting North European seas. The first investigation of this kind was made by Matthews, for the Scottish Fishery Board, about the end of last century, and somewhat later Heincke made a similar study of herrings obtained mainly from the Baltic. Criticism of Heincke's work showed defects of treatment, and his conclusions, as well as those of Matthews, were seen to be of little value since they were deduced from insufficiently large samples. As the question of the distribution of local races of herrings has considerable importance in fishery regulation, the Board of Agriculture and Fisheries organised, in 1913, a comprehensive scheme of investigation applying to all parts of the British seas, and a number of fisheries laboratories arranged to take part in the work. One result of the war has been, of course, the suspension of most of this investigation, but fortunately all the organisation had been completed prior to August, 1914, and some progress was made during 1915. Dr. Orton, in the paper now noticed, gives an account of the practical methods employed at Plymouth by himself and his colleagues. Some eighteen variable characters were measured in each of well above 1000 herrings. As there is no immediate likelihood of a general discussion and analysis of all the results obtained by the Board, the details of this investigation of the Channel herrings are now tabulated and published.

In Kew Bulletin, No. 2, 1916, several new species of plants are described from India, China, and Africa. Among the African species is *Gardenia fragrantissima*, Hutchinson, of which an illustration is given; *Utricularia papillosa*, Stapf, from Nigeria; and an interesting Asclepiad, *Caralluma carnosa*, N. E. Brown, from the Transvaal, which is illustrated by a plate from a photograph taken in the garden of the Botanical Laboratory, Pretoria, by Mr. Pole Evans, the discoverer of the species. Two interesting and little-known South African Euphorbias are also illustrated by a plate in this number, *E. pubiglans*, a native of Port Elizabeth, and *E. enopla*, with fierce spines which are modified peduncles, from the Witte Poort Mountains and the Karoo.

A sumptuously illustrated paper by Mr. S. Okamura on the mosses of Japan has recently been issued as article 7 of vol. xxxvi. of the Journal of the College of Science, Tokyo. These contributions include citations of new localities and descriptions of new species from the island of Sachalin and from the Corean peninsula. Among the new species may be mentioned a minute and interesting Archidium, *A. japonicum*, with a stem 2–5 mm. high, from the Prov. Musashi, Hondo. *Schistostega osmundacea*, the luminous moss, is now recorded from several localities in Japan for the first time, having previously only been known in Europe and North America. A new aquatic moss, *Bryhnia Nakanoi*, is also described and figured.

One of the railway problems of the near future must be the linking of the Balkan lands to western Europe by a route independent of the Central Powers. To find an alternative to the railway route *viâ* Vienna and Budapest to Constantinople will strengthen the relations of Italy and France with the Balkan people at the expense of Austria and Germany. In a paper on the Adriatic Slavs (*Geographical Journal*, xlvii., April, 1916), Sir Arthur Evans advocates the reopening of the old Roman route by the Save valley from Lombardy to Belgrade. A few miles between existing railways would make the line complete from west to east, and, subject to the formation of a South Slavonic State in the Illyrian region, would constitute a route to Belgrade more direct from France and England than that *viâ* Vienna. By Milan, Padova, Gradisca, and Laibach, it would be possible to reach Belgrade from London in thirty-nine hours, compared with 44½, the time taken by the Orient express before the war. The saving in time would be proportionately much greater from many parts of France. In connection with this article attention may be directed to another, in the same number of the *Geographical Journal*, by Mr. H. C. Woods, on communications in the Balkans, which is illustrated with maps.

Prof. A. Riccò has contributed to the Italian Seismological Society an interesting paper on the distribution of the epicentres of the greater Italian earthquakes (Bollettino, vol. xix., 1915, pp. 35–47). He shows that these epicentres are arranged chiefly about the crest of the Apennines and its continuations. The distance between successive epicentres varies from 25 to 110 km., the average distance being 50 km. The area of total or partial ruin is usually bounded by a curve, which is elongated in the direction of the mountain-chain, and the longer axis of this curve varies in length from 30 to 300 km., the average length being more than 120 km. Thus the greater part of the Apennine axis is marked out by the ruins caused by earthquakes. Prof. Riccò notices that the same centre is often revisited by great earthquakes; for example, eight earthquakes have originated in the Norcia centre from 1328 to 1860, and ten in the Cassino centre from 1004 to 1891.

The Canadian Department of Mines has issued a very full description of the Canadian oil-fields under the title of "Petroleum and Natural Gas Resources of Canada," in two bulky volumes. The first volume deals with the occurrence and distribution of oil-fields in various parts of the world, with the chemical and physical properties of petroleum and natural gas, and the methods employed in drilling wells, in pumping, storing, and transporting oil and gas, and with the utilisation and conservation of these substances; the second volume contains a detailed description of the various Canadian oil-fields. The work is one of the

greatest value to all interested in any aspect of this very important industry. In this connection attention may be directed to the very full account of the natural gas industry to be found in a paper by Dr. J. A. L. Henderson, read on March 21 before the Institution of Petroleum Technologists.

IN the *Rassegna Nazionale*, xxxviii., (2), 1, a fortnightly review dealing mainly with politics and literature, science is represented by a popular article on "Infinity" by Pietro Pagnini, in which the peculiarities of infinite space, time, and number are discussed.

ABOUT the first fortnight of March, 1915, the peach blossoms in the gardens at Rome were damaged by the larvæ of a micro-moth identified as *Recurvaria nanella*. An account of the biology of this insect is given by Armando Mignone in the *Atti dei Lincei*, xxv., (1), 3, 5. It belongs to the family Gelechiidæ, and the description of the European form appears to be identical with Scott and Paine's observations in the United States. The imago spends most of the day resting with wings closed on the peach and certain other fruit trees. The larvæ, which are hatched in the autumn, are leaf-miners, making long tunnels in the leaves. In the winter they come out and hibernate in places where they are almost invisible, investing themselves with a silk covering, and the following spring they emerge and attack the young buds.

SPECIAL PUBLICATION No. 33 of the Department of Commerce of the United States Coast and Geodetic Survey deals with the results up to the present time of the magnetic survey of the country and of the adjoining seas. These results are given in the form of tables, and are embodied in a chart to a scale of about 110 miles to the inch. The *isogonic lines*, or lines of equal deviation of the compass from true north, are drawn for each degree of deviation from 24° east in the north-western States to 24° west in the north-eastern States. The date for which they hold is January 1, 1915. In the north-western States the isogonic lines run nearly east and west, in the central States nearly north and south, and in the eastern States north-west to south-east. In the west and south they are fairly regular in shape, but in the east and in the regions south of the great lakes they are much folded. Along a line from Florida to a point 100 miles west of Lake Superior there is no secular change in the deviation of the compass; at points east of this the north end of the compass needle is moving to the west at a rate which exceeds six minutes of arc per annum in the north-eastern States, and at points west of the line the north end is moving to the east at a rate which is nearly four minutes per annum in the south-western States.

THE *Royal Engineers' Journal* for April contains an article on explosives compiled from one which appeared originally in the *Revue Militaire Suisse*. All the more generally used explosives are described, with some account of their manufacture. No mention is made, however, of modern methods of making nitrocellulose; only the old pot method is described. Similarly, recent improvements in the manufacture of nitroglycerine are not referred to. Reference is made to the interesting explosive residue left when a rhodium-zinc alloy is dissolved in hydrochloric acid, this residue exploding when heated to 400° C. in a vacuum. In conclusion, it is pointed out that it is by no means possible to state definitely which is the best of the "high explosives"; probably the most powerful one in use is tetranitroaniline. It would be extremely difficult to produce a substance having greater explosive force than those already discovered and in use at the present day. Whether any advantage would be gained by the discovery of explosives which are more powerful than those already in use is another matter. With "high explosives," once it is possible to plant them on the exact spot at which it is desired to effect destruction, such destruction can be effected with as great completeness by the employment of one of the present-day "high explosives" as with any new one which may be discovered. On the other hand, any increase in the "safety" properties of "high explosives," and improvements in other directions tending towards facilitating their transport, would be a gain from a military point of view.

R. L. DATTA and N. R. Chatterjee have recently described (Journal of the American Chemical Society, 37, No. 3) the action of aqua regia on acetone, ether, methyl, ethyl, and allyl alcohols, and formic and acetic acids, with the production of chloropicrin. The yield of the latter substance is almost quantitative in the case of acetone and allyl alcohol when the reaction mixture is warmed. It is stated that the following method of preparing chloropicrin is far preferable to Hofmann's method in which bleaching powder is allowed to act on picric acid. To a mixture of two parts of nitric acid with three parts of hydrochloric acid, a quantity of acetone equal to one-tenth part of the acid mixture used is gradually added, the reaction mixture being warmed slightly. After heating on a water-bath to complete the reaction, the liquid is steam-distilled, the compound separated, dried over calcium chloride, and finally redistilled at a slightly reduced pressure.

MESSRS. GEORGE ALLEN AND UNWIN, LTD., are publishing at an early date, for the Polish Information Committee, pamphlets entitled "The Landmarks of Polish History," "The Polish Question as an International Problem," "An Outline of the History of Polish Literature," "National Music of Poland," and "Poland as an Independent Economic Unit." Further pamphlets, entitled "A Sketch of Polish Art," "The Population of the Polish Commonwealth," "Poland as a Geographical Individuality," and "Intellectual Poland," are in active preparation.

OUR ASTRONOMICAL COLUMN.

VARIABLE STARS OF SHORT PERIOD.—Prof. E. C. Pickering directs attention to some similarities and peculiarities in the formulæ representing the light variations of the typical short-period variable stars (Circular 190, Harvard College Observatory), not only affording criteria for purposes of classification, but also indicating structural features. It is found that β Lyræ should be regarded as intermediate between the Algol eclipse variables and the δ Cephei stars—exactly the order, it may be added, demanded by Sir Norman Lockyer's meteoritic hypothesis.

PHOTO-ELECTRIC PHOTOMETRY.—Prof. J. Stebbins gives some details regarding the employment in stellar photometry of a specially sensitive rubidium cell (Lick Observatory Bulletin, No. 277). This particular cell is an outcome of some two years of conjoint research with Prof. J. Kunz. The observational work was carried out at Mount Hamilton, June 21–July 30 last year, and several sets of measures are included for nearly every day during the interval embracing three cycles of the star's period. Important real irregularities are revealed, but the mean light curve has nevertheless been determined. The two maxima are found to be practically equal. A marked asymmetry of the light curve on each side primary minimum (the decrease of light being more rapid than the increase) is explained by an assumed non-uniform surface intensity

of the apparent discs of the component stars. In addition to this important work, some measures of the light of the spectroscopic binaries, and thus "suspect" eclipse variable stars θ Aquilæ and σ Scorpii are given. In spite of the very short period of the latter star, 0·2468 day according to Father M. Selga, the evidence points to a slight variation.

THE MOTION OF THE SIDEREAL UNIVERSE.—The view that the galactic system is but a model of many has been supported by additional evidence since the "white" nebulæ were identified with remote galaxies. Such evidence is found in the very high line-of-sight motions, and the dark-line spectra of the spiral nebulæ, the probable finite dimensions, spiral structure, and integrated spectrum of the Milky Way itself. Quite lately this idea has inspired some researches necessarily of a tentative character. Messrs. R. K. Young and W. E. Harper have, in fact, made a determination from the data at present available concerning the radial velocities of some sixteen nebulæ, of the direction and magnitude of the translational motion of the solar subuniverse (Journal of the Royal Astronomical Society of Canada, No. 3). The deduced velocity is 598 km./sec. ($2\frac{1}{2} \times$p.e.) towards R.A. 20h. 24m., and declination $-12°$. Very nearly the same results have been obtained independently. According to the *Observatory* (March) Mr. Truman finds that our nebula is moving towards R.A. 20h., declination $-20°$, with a speed of 670 kilometres per second.

THE WAVE-LENGTHS OF THE CHIEF NEBULAR LINES.—An extensive series of measures of the two chief nebular lines has been made at the Lick Observatory (Bulletin 279). Nineteen spectrograms of the three nebulæ, N.G.C. 6572, 7027, and Orion, were measured by each of three observers, the resulting wave-lengths being 5006·847 and 4958·902 I.A. The method of reduction is not fully described, but the use of a reduction curve connecting micrometer measures and wave-lengths showed that Runge and Paschen's wave-length 5015·73 Å. for this helium line is 0·12 Å. too small. Corrections for radial velocity were calculated from the displacements of H_β. Combined with Keeler's, Hartmann's, and Wright's (recalculated) the rounded, weighted means are:—

5007·02	4959·09 A. (Rowland).
5006·84	4958·91 I.A.

ENGINEERING AND SCIENTIFIC RESEARCH.

IN a paper before the Society of Engineers on May 1 Prof. J. A. Fleming emphasised the necessity of bringing scientific discovery and research to bear upon our national industries. It is estimated, he said, that not less than 1,000,000,000*l*. is invested in material and plant used in the mechanical and electrical engineering industries in this country.

Progress is hampered by want of co-ordination between the various learned and technical societies and by the conservative element in our universities and public schools. We have to consider (1) improvements in training men who will become engineers; (2) the best means by which science can be brought to bear on engineering problems; and (3) scientific methods in relation to the business side of engineering.

In our present educational system, Prof. Fleming added, too much attention is devoted to the cultivation of memory and words, and too little study is devoted to the facts of nature and the power to draw correct inferences from observation. One barrier in the way of industrial progress has been the imperfect scientific training of foremen, managers, and young heads of departments in engineering works. A much-needed educational reform is the compulsory attendance of lads after leaving the elementary school at a technical continuation school. Certificates issued by such schools should have an important determining influence on a boy's future, and should be valued accordingly.

Students at technical colleges should avoid undue specialisation and should be encouraged to acquire a broad knowledge of the principles of chemistry, mechanics, physics, mathematics, and metallurgy.

Research work may be divided into three departments:—(1) Those which aim at determining physical constants; (2) those providing new methods of examination and tests of material and structures; and (3) those leading to the discovery of some new process, material, or machine. In the first two departments there is great scope for further work. As instances of recent valuable work of this character, Prof. Fleming mentioned metallography, the development of high-temperature thermometry, and the recent application by Prof. E. G. Coker of polarised light in studying the stresses in celluloid models of beams, struts, riveted plates, etc.

A good instance of the third branch of research work was the simultaneous discovery in France and the United States of the electrical treatment of fused cryolite to produce aluminium in bulk. This third section of research work calls for special gifts, and it is important to study the conditions which give rise to this originative power. While natural ability plays a great part, effort should be made to utilise the power of inspiration possessed by some great investigators like Lord Kelvin and Clerk Maxwell. The existing centres of research, such as the Cavendish Laboratory at Cambridge, the Royal Institution, and the National Physical Laboratory, should be more fully supported. An important step has been the establishment of the Advisory Council on the Development of Scientific and Industrial Research, and it is satisfactory to find that its aid is being given largely through the intermediation of established professional and technical institutions and societies. In dealing with new problems it is highly desirable to utilise, so far as possible, existing channels of information and inquiry.

Abroad much technical research work is carried out on behalf of private associations of manufacturers in particular industries, and it is to be hoped that British firms will develop this co-operative method of stimulating and utilising research. The same applies to the collection and dissemination of information of industrial value, and to the general scientific organisation of the business side of engineering. The subsidisation of private or national research work by Government funds is but a small part of the whole problem.

In the ensuing discussion Col. R. E. Crompton contended that the British mind possesses the originative powers in a high degree. He recalled that much of the pioneering work in electrical matters was done in this country, and the later advance in Germany was due to better organisation, more general appreciation of the benefits of applied science, and the support of the industrial banks. Scientific and technical education on a far greater scale is needed. Other speakers agreed in advocating more systematic education in scientific matters, and fuller co-operation between the manufacturers and those engaged in scientific work, and a number of instances of valuable research work, initiated since the outbreak of war, were mentioned.

The view was expressed that the co-operation of scientific and technical societies and journals should be more fully utilised with a view of bringing the benefits of scientific method and research to the notice of manufacturers in this country.

M. CH. LALLEMAND ON DAYLIGHT SAVING IN FRANCE.

M. CH. LALLEMAND, who was appointed *Commissaire du Gouvernement* to inquire into the effect of a modification of time reckoning, when the question was raised in an acute form nine years ago, gave to the Paris Academy of Sciences on April 10 a reasoned statement of the whole problem. The question he raises is: Would, even in the exceptional circumstances of the time in which we live, the advantages of this change be of such a nature as to counterbalance the profound disturbance which could not fail to be introduced into the economic life of the people? The conclusion at which he arrives is that the reform in question offers illusory or insignificant advantages in return for certain and definite inconveniences.

This decision is the result of a careful examination of the changes that have been made in the methods of time reckoning in the past, and a review of the exact conditions that obtain in the present. In his historical survey he demonstrates the jealousy with which the French adhered to the observance of the Paris meridian as the origin of time, and the dislike exhibited to any proposal that interfered with the mode of reckoning. In 1816, when the change was made from apparent to mean time, so keen was the antipathy displayed by the populace that an outbreak was feared, and yet in that case the maximum alteration was at most a quarter of an hour. But he is more concerned to show that the position of the sun in the sky affords the proper determination of time, and that an arbitrary displacement of noon, combined with differences of longitude, operates very unequally in districts east and west of Paris. If legal authority sanctioned the further displacement of an hour, as proposed, though Nice, for example, would not be injured, Brest time would, in extreme conditions, be as much as 1½ hours away from true time, an amount that M. Lallemand insists is intolerable.

The last change introduced into French time computations was the adoption of the Greenwich meridian as a common origin for time reckoning, and some irritation is naturally felt that after this concession was made, the English should propose to abandon their system of time reckoning for at least half a year in order to adopt what is practically German time. Such instability of practice is inconvenient, but a more direct source of trouble would arise from disturbing the published ephemerides which give phenomena expressed in Greenwich time. This duality of timekeeping during six months of the year would be, in the case of tides especially, a source of great annoyance and perpetual confusion.

M. Lallemand devotes a section to the consideration of the advantages claimed by the advocates for the reform. He examines the methods of street illumination, and claims that the people living in the country districts, some four-fifths of the whole, would receive a quite insignificant benefit. In many manufactories as at present conducted, work goes on night and day, and no economy could be effected in this direction. In Paris the illumination is reduced to a minimum on account of the Zeppelin visits. The custom adopted in colleges and schools would likewise prevent these establishments profiting by the proposal. Cafés, restaurants, theatres, concert-rooms, might now close an hour sooner, if economy were so ardently desired, and the desired result could be as easily secured by a simple order of police as by a general interference with timekeeping. In any case, it is questionable whether those interested in the management of such places of amusement would not apply for an extension of time and re-establish the *status quo ante*.

Hygiene is as little likely to benefit as economy. It is an illusion to suppose that an arbitrary alteration of the hands of the clock dial will promote early rising, or retiring, on the part of those who have surrendered themselves to other habits; it would be as reasonable to attempt to fight alcoholism by diminishing the legal capacity of the litre, in the hope of reducing in the same proportion the quantity of liquid absorbed. It is not true to suppose that the nominal hour and the true hour have no influence in practice, or that the habits of the people are decided solely by clocks, and have no relation to the sun. The change in the breakfast hour in Paris refutes such a notion.

To prove that the abrupt advance of time in the spring, and its equally sudden restoration in autumn, would be accepted by the public with indifference, it is usual to point to the ease with which travellers accommodate themselves to the change in time when passing the boundary of a longitude zone. The comparison is not convincing. In the particular case cited the error of legal noon changes its sign but keeps nearly the same absolute value, which is the only thing that matters.

FLORAS AND GEOGRAPHICAL DISTRIBUTION OF PLANTS.

OUR knowledge of the flora of Siam, and especially of the neighbourhood of Chiengmai, has grown rapidly during the last few years owing to the extensive collections made by Dr. Kerr, and more recently to the activity of the forest officers. In the Kew Bulletin, 1911, an important paper entitled "Contribution to the Flora of Siam" was published, the introductory matter being supplied by Dr. Kerr and the determinations and descriptions by Mr. W. G. Craib. Since then seven papers dealing with additional new species, described by Mr. Craib, have been published in the Kew Bulletin from time to time. In the last number of this journal for 1915 (No. 10), the eighth "additamentum," containing descriptions of twenty-seven new species, has appeared, belonging to various natural orders. For most of these Mr. Craib is responsible, but for three new Ampelideæ and a Dalbergia he is associated with M. Gagnepain.

The flora of the high mountains of Malaya is of particular interest in connection with the geographical distribution of plants, since here are to be found the meeting ground of Australian and Himalayan plants. Mr. H. N. Ridley in 1912 made an expedition to Gunong Tahan in northern Pahang, the results of which have just been published in the Journal of the Federated Malay States Museums (vol. vi., part iii.), and his account, taken in conjunction with what we know of the flora of Mt. Ophir and Kedah Peak, makes possible a general survey of the relations of the high mountain flora of the Straits Settlements with the flora of Kinabalu, in Borneo, and Australia, on one hand, and with that of the northern regions on the other. The Himalayan element found in the Telôm Valley, Perak, seems to be remarkably absent from Tahan, but in the xerophytic regions of the sea coasts and the higher mountains Australian plants are found. On Kinabalu, however, the Australian element is more pronounced than on Tahan, and in New Guinea it appears yet larger. It would seem that at one period an extensive xerophytic area stretched from the Australian region bearing its characteristic flora, but that owing to climatic changes it was swamped by a typical Malay rain-forest flora, and only now persists on sandy seashores and dry mountain tops. Five Kinabalu plants found on Gunong Tahan are not known from elsewhere in the Malay Peninsula, and since they have neither drupaceous nor wind-borne seeds a former land connection with Kinabalu is assumed.

ILLUSIONS OF THE UPPER AIR.[1]

A REVIEW OF PROGRESS IN METEOROLOGICAL THEORY IN ENGLAND SINCE 1866.

Structure of the Atmosphere according to the Observations of the Upper Air.

BUT if the ideas which were common in meteorological practice fifty years ago are now to be regarded as illusory, let us consider what we have in their place. We go back to the three elements: the circulation, the convergence, and the convection. As to the circulation, we now think of it as it is exhibited in the upper air, and instead of regarding it as an incidental disturbance of the motion from high to low, we regard it as the foundation of atmospheric structure; as the motion of air which is persistent because the pressure-gradient is balanced by the centrifugal action of the earth's rotation, which we may call the geostrophic component, and of the curvature of the path over the earth's surface, which we call the cyclostrophic component. If the balance between velocity and pressure is not perfect, the difference from perfection can be only infinitesimal, because in the free atmosphere the air must always begin to adjust itself to the strophic balance from the moment that any infinitesimal change becomes operative, and the power of adjustment arising from the extreme mobility of the air prevents any finite perturbation being set up, except temporarily in those regions where violent convection is operative. It is only through the mobile air that perturbation can be transmitted. We no longer picture to ourselves the air as being somehow held firm without moving until a pressure distribution is set up and then let go; the first symptom of pressure-difference will be the occasion of motion, the distribution and velocity grow together; they adjust themselves automatically. The whole history of the general motion of the atmosphere is the story of the constant pursuit of the strophic balance, the adjustment of velocity to pressure, constantly disturbed by infinitesimal changes.

Near the surface things are much more complicated, because there is turbulence due to the interference of the surface and the obstacle which it offers to the steady progress of air. The air loses some of its motion, and is exposed to the pressure without the velocity that is required to balance it. It must, therefore, fall away towards the low pressure, taking out of the pressure the energy necessary to provide for the loss by friction. Thus the convergence which we have to account for is only that shown near the surface within half a kilometre. We need not trouble ourselves about a supposed convergence and convection over the whole area in the upper air. The second element of our specification disappears. After years of contemplation of the motion of the air from high to low as produced in a quiescent atmosphere by the operation of pressure-difference and kept within bounds by friction, we now regard the motion from high to low as actually caused by the friction which retards the velocity required to maintain the strophic balance. To base the theory of motion of the upper air upon the idea of a given distribution of pressure setting a quiescent atmosphere in motion is as great an error as to begin the lunar theory by supposing the moon to start from rest under the force of the earth's attraction, and only to find out after it had started that the earth was moving.

As to convection, there is certainly convection wherever there is instability or the juxtaposition of air of different densities. It takes a great variety of forms; it is very common in cyclones, but it is not a necessary attribute of them. Possibly it is set up there more easily because the air travels so much faster in cyclonic areas than it does in anticyclones, and adjoining localities are fed from different sources of supply. Apart from a certain interference due to change of latitude, the convection is probably the one disturbing cause of the strophic balance of velocity and pressure. So we regard the troposphere as a layer of about 9 kilometres thick, always striving to arrange its motion according to the pressure, and perpetually baffled in its endeavours by the ubiquity of convection. But since all the changes proceed by infinitesimal steps, there is never a time when we can identify a state of finite divergence from the balance between velocity and pressure. From this point of view the centre of a cyclonic or anticyclonic system has no special dynamical importance. It becomes a notable feature on the map when for any reason the cyclostrophic component is the chief element in balancing the pressure. That is seldom the case in our maps, which more often consist of isobars of complicated shapes.

The Dominance of the Stratosphere.

Further than this, Mr. Dines has thrown a new light upon the origin of differences of pressure at the surface by obtaining the correlation coefficient between corresponding deviations of pressure from the normal at the level of 9 kilometres and at the ground, and has obtained results "ranging from 0·67 for the last available set of a hundred soundings on the Continent to 0·88 for soundings in England grouped for the winter season." Moreover, the standard deviations are of the same order of magnitude at both levels—that is to say, both levels are subject to similar changes. At the same time, the correlation coefficient between the pressure at the surface and the mean temperature of the 9-kilometre column is small; in other words, the temperature of the lower strata of the atmosphere has, on the whole, little to do with the general distribution of surface-pressure in this country. Its effects are local.

We must therefore regard the general flow of air, except in so far as it is disturbed by convection, as governed not by what happens at the surface, but by what is imposed upon it from the stratosphere above. It is from there that the general control of the distribution of our pressure comes. It is only modified by what happens below. The upper air, the stratosphere, is the operator, and the lower air the subject operated on. After fifty years of strenuous endeavour to regard the surface as the operator and the upper air as the subject, the exchange of *rôle* is very disturbing, but it has its compensations. There are many things which can easily be explained by operation from above, but only with the greatest difficulty by operation from below. Let us indulge in some speculations which follow from supposing that the stratosphere operates upon the troposphere. It makes the troposphere as tuneful as an organ under the alternating rarefaction and compression caused by the changes in the stratosphere. Every cloud is the subject of its action. One can imagine them being developed, showing first the region of greatest humidity, like the development of a photographic plate, which further develops into loss of stability, and so into cumulus-cloud and a shower. And let us not forget that each several cloud means the disturbance of the normal circulation; the condensation will alter locally the horizontal distribution of temperature, and therefore that of pressure and wind. On the table are two autochrome photographs of the western sky at Ditcham Park, with a quarter of an hour's interval, on a September evening in 1911, with gradually reddening clouds that gradually vanished as they approached from the west. Nothing could be more attractive than to speculate upon such changes in relation to the changes of pressure in the stratosphere

[1] From a discourse delivered at the Royal Institution on Friday, March 10, by Sir Napier Shaw, F.R.S. Continued from p. 194.

The Régime of the Stratosphere.

But our new point of view only shows our problem removed one step further; we have now to begin again and imagine for ourselves what is the *régime* of pressure and winds in the stratosphere until the enterprise of meteorologists completes our knowledge of what it actually is. The problem is, at any rate, much simplified, because convection is avoided; we deal with an atmosphere which, being nearly isothermal, is inherently stable; density goes directly with pressure, layer lies on layer like a light liquid on a heavy one; temperatures are uniform, or very nearly so, in the vertical direction, and therefore isotherms are also isobars, and winds are proportional everywhere to pressure-differences—that is, to temperature-differences. Outside the equatorial region the rotation of the earth secures that air always moves along the lines of pressure, keeping high pressure or low temperature on the right. So the general idea is simple, but whether the streams of air are long, straight currents or centrical whirls we do not yet know.

Numerical Calculations.

Speculations of a qualitative character are apt to lead the speculator into serious error; the real test of any physical theory is its quantitative application.

It will be of great advantage to the further development of our ideas if we can trust implicitly to the hypothesis of pressure balanced by motion (let us call it the principle of strophic balance) as the foundation of the structure of the atmosphere, and that hypothesis will be confirmed in the orthodox scientific manner if the quantitative conclusions to be drawn from it are verified by observation. I propose to ask your attention to some applications of that hypothesis which can be tested numerically.

From this point of view the theory of strophic balance has the great advantage of giving a definite relation between wind velocity, pressure, and temperature, and therefore brings the relations between all these quantities within the region of arithmetical computation.

Let us consider some of these relations. We require a number of symbols for the meteorological quantities :—

p	represents the atmospheric pressure
θ	" " " temperature
ρ	" " " density
l	" " horizontal distance
h	" " vertical height
$s\left(=\frac{dp}{dl}\right)$	" " horizontal pressure gradient
$q\left(=\frac{d\theta}{dl}\right)$	" " " temperature gradient
v	" " velocity of the wind
$R=p/(\rho\theta)$	" " constant of the gas equation.

Certain geodesic quantities also come in, viz. :—

E, the radius of the earth.

g, the acceleration of gravity.

r, the angular radius of a small circle on the earth's surface which indicates the path of air in a cyclone.

λ, the latitude of the place of observation.

ω, the angular velocity of the earth's rotation.

We require also some convention as to the positive and negative of v.

v positive represents the winds when the pressure-difference Δp represents higher pressure on the right of the path.

The fundamental relation between the velocity of the wind at any level and the pressure-gradient there is :—

$$s=\frac{dp}{dl}=2\omega v\rho\sin\lambda\pm\frac{v^2}{E}\rho\cot r \quad . \quad . \quad (F)$$

The two terms which make up the right-hand side of this equation are of different importance in different places and circumstances; for example, if the air is moving in a great circle, r is 90° and cot r is zero; the first term alone remains. On the other hand, at the equator the latitude $\lambda=0$, sin λ is zero, and the second term alone remains. Away from the equatorial region the second term is relatively unimportant unless the velocity v is great. In temperate and polar latitudes the path of the air differs little from a great circle except in rare cases near the centre of deep depressions; consequently the first term may be regarded as the dominant term in these regions.

We call the wind computed according to the first term the geostrophic wind, and regard it as generally representing the actual wind of temperate and polar regions.

We call the wind computed according to the second term the cyclostrophic wind, and regard it as representing the actual wind (in so far as there is any regular or persistent wind at all) in the equatorial regions. It represents the wind of tropical hurricanes, and winds of the same character may also occur locally in temperate regions as tornados and other revolving storms.

Thus we have the following auxiliary equations :—

Horizontal gradient of pressure	$s=\frac{dp}{dl}$
Horizontal gradient of temperature	$q=\frac{d\theta}{dl}$
Winds of temperate and polar regions—geostrophic winds	$s=2\omega v\rho\sin\lambda$ . . (1)
Winds of equatorial regions—cyclostrophic winds	$s=\rho\frac{v^2}{E}\cot r$ . . . (2)
The measurement of pressure	$\frac{dp}{dh}=-g\rho$ . . . . (3)
The gaseous laws (assumed for dry air)	$p=R\rho\theta$. . . . . (4)

From these by simple manipulation I have deduced the following :—

For change of pressure gradient with height	$\frac{ds}{dh}=g\rho\left(\frac{q}{\theta}-\frac{s}{p}\right)$ . . (A)
For change of wind velocity with height—geostrophic winds	$\frac{dv}{dh}=\frac{v}{\theta}\frac{d\theta}{dh}+\frac{g}{2\omega\sin\lambda}\frac{q}{\theta}$ (B)
cyclostrophic winds	$\frac{dv^2}{dh}=\frac{v^2d\theta}{\theta dh}+\frac{gE}{\cot r}\cdot\frac{q}{\theta}$ (C)

Deductions from the Theory of Equivalence of Pressure-distribution and Wind.

These equations serve to explain the following facts established by observation[5] :—

1. *Light winds in the central region of an anticyclone.*

It follows from the fundamental equation F when the negative sign is taken, as it must be for an anticyclone, that the values of v will be given by the roots of a quadratic equation, which will be impossible if v is greater than $\frac{E\omega\sin\lambda}{\cot r}$. This, for a circle of 70 miles' diameter, only allows a velocity of about 4 metres per second.

This is confirmed in practice, and furnishes a

[5] The following references may be given for the statements enumerated here :—(1) Barometric Gradient and Wind Force. Report by Ernest Gold. M.O. Publication No. 190. (2) Shaw, Journal of the Scottish Met. Soc., vol. xvi., p. 167, 1913. (3) Shaw, Q. J. Roy. Met. Soc., vol. xl., p. 111, 1914. (4) The Free Atmosphere of the British Isles. Report by W. H. Dines, F.R.S. M.O. Publication, No. 202. C. J. P. Cave, The Structure of the Atmosphere in Clear Weather. (Cambridge University Press.) E. Gold, The International Kite and Balloon Ascents. Geophysical Memoirs, No. 5. M.O. Publication 210e. The computations of equations B and C are not yet published; the direction of the wind is regarded as not being subject to change with height. (5) Shaw, Principia Atmospherica. Proc. R.S.E., vol. xxxiv., p. 77, 1914.

crucial test of the two theories. If an anticyclone is a place where air descends and flows outward, its velocity should diminish as the air spreads outwards; but the reverse is the case with an anticyclone.

2. *The small influence of the troposphere, and therefore the dominance of the stratosphere, in the distribution of surface pressure.*

This follows directly when numerical values are inserted in equation A. The right-hand side of the equation consists of two terms which are of opposite sign and, numerically, approximately equal in the middle regions of the troposphere. Their combined effect for the whole range is therefore relatively small, and the change of pressure produced in the troposphere is unimportant. The distribution of the stratosphere is dominant throughout the troposphere.

3. *The apparently capricious variations of wind and temperature with height disclosed in pilot-balloon ascents and by ballons-sondes.*

The results of the observations of ballons-sondes show local variations of temperature and those of the observations of pilot balloons show similar variations of the direction and velocity of wind. These variations can be connected numerically by Equation A in

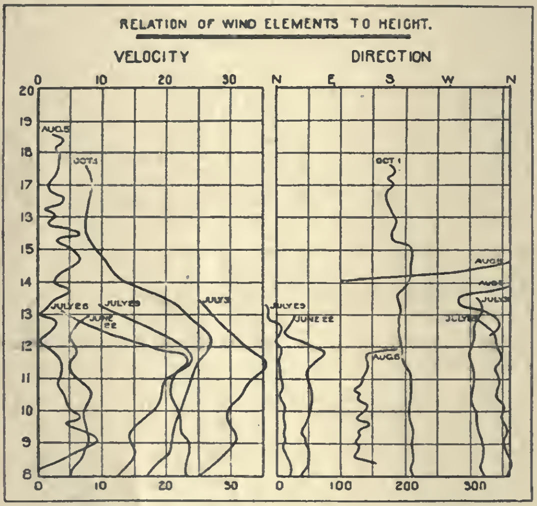

FIG. 1.—Diagrams showing the falling off of wind velocity in the stratosphere (about 11 kilometres). The scale on the left gives the heights in kilometres, those at head and foot the velocity in metres per second, and the direction in degrees from north respectively.

combination with Equation 1. A number of examples are given in a paper read before the Royal Meteorological Society. To quote one, the rapid transition from a southerly wind at 1100 metres through a calm to a northerly wind at 1500 metres on October 16, 1913, was shown to indicate a temperature gradient of 7° per hundred kilometres towards the east, a condition that was in satisfactory accord with the meteorological circumstances of the time.

The same combination of equations enables us to specify the *conditions under which "Egnell's law,"* that wind velocity at different heights is inversely proportional to the density at those heights, may be expected to be verified and the conditions prescribed are essentially reasonable.

4. *The rapid falling off of wind in the stratosphere noted in observations with pilot balloons.*

This is illustrated by Fig. 1, a diagram compiled from the figures of high soundings reproduced in Captain Cave's "Structure of the Atmosphere in Clear Weather." The result follows directly from the application of Equation B to the special conditions of the stratosphere. The computations for the four occasions in which there was a wind of considerable magnitude at the base of the stratosphere give the following results:—

Date 1908	Rate of change of velocity in the stratosphere m/s per kilometre	Horizontal temperature gradient: Computed. Degrees per 100 kilometres	Horizontal temperature gradient: Observed. Degrees per 100 kilometres
October 1	− 7	2·1	—
July 31	− 5	1·5	—
July 29	− 11	3·3	3·3
July 28	− 13	4·0	—
July 27	—	—	2·5

The calculation has been arranged to give the computed horizontal temperature-gradient, because the

FIG. 2.—Glass model showing the distribution of temperature in the atmosphere on July 27, 1908. Isotherms are drawn for every 5° A., and the thickness of each line represents half a degree except in the case of the isotherm of 273°, which is covered by a band 5° in width. The height of the model represents 24 kilometres. The tilting upward of the isothermal lines shows the commencement of the stratosphere at about 11 kilometres.

values of that quantity can be taken directly from the models of temperature distribution constructed in the Meteorological Office for July 27 and 29, Figs. 2 and 3. The order of magnitude which is indicated is quite reasonable, and for the one occasion on which the two can be compared the agreement turns out to be exact. That may be fortuitous; but we may take advantage

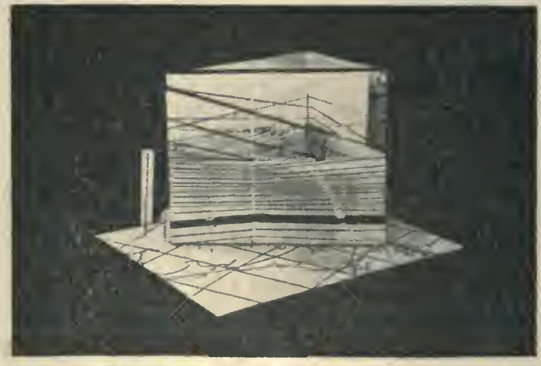

FIG. 3.—Model showing the distribution of temperature in the atmosphere on July 29, 1916. In each case the model stands on a map of the British Isles upon which the isobars are shown. In the interval of two days a layer of cold air spread itself along the base of the stratosphere from the east, and raised the surface pressure by about 10 ml.

of the circumstance to use the combination of the figures for the wind in the stratosphere and the horizontal temperature gradient at 13 kilometres to compute the latitude of the place of observation with an accuracy that may lead us to reconsider the common remark that meteorology is not an exact science.

The same equation applied to the troposphere, *assuming normal values for temperature, gives cor-*

rectly the rate of change of velocity with height, as shown in the corresponding diagram.

5. *The permanence of vertical motion about a vertical axis in the atmosphere, which is indicated by the long travel of cyclonic depressions.*

From Equation C applied to the stratosphere it follows that a circulation in the base of the stratosphere with a given horizontal temperature gradient, such as is found there, will have only a limited extension upwards. With a wind velocity of 20 metres per second and a horizontal temperature gradient of 5° per hundred kilometres, the extension will be 1·4 kilometres upwards; so that the vortex will be covered by a cap in which the velocity gradually falls off to zero within a very limited height.

For the extension downward the calculation is more complicated, but the computed change of velocity is very small, so that the vortex must be regarded as reaching the ground; and it would appear that a vortex extending throughout the troposphere terminating with a cap in the stratosphere is a possible reality.

Thus the hypothesis of an atmosphere in which the wind velocity is everywhere adjusted to balance the pressure distribution enables us to explain many of the ascertained facts that have been disclosed by the investigation of the upper air, and strongly supports the idea that the pressure distribution at the surface is controlled by the stratosphere and only modified locally by convection.

Against the control of the distribution of pressure by the upper atmosphere may be urged the formation of anticyclones over the relatively cold areas of sea and land, especially the winter-anticyclones of the great continents of the northern hemisphere. For the local effect of surface-cold we have to bring into account the effect of eddy motion, some examples of which are given in the "Meteorological Report of the Voyage of the *Scotia* in 1912" by G. I. Taylor, published by the Board of Trade in 1913.

If apology be needed for dealing with fundamental hypotheses like these at a time when the attention of the nation is more especially directed to forecasting and other practical problems of the upper air, it is to be found in the fact that it is of the highest importance that meteorologists who have to advise the men of action upon practical questions should approach the consideration of those questions without the bias which necessarily attaches to an erroneous fundamental principle of long standing. The number of meteorologists who are so engaged is at present small —too small for the various duties that belong to the establishment of a proper understanding with regard to the study of weather. But it is increasing, and it must be increased in various ways if those who entrust their lives and fortunes to the free atmosphere are to enjoy all the advantages to which their experience entitles them.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The late Lady Kelvin of Largs, widow of Lord Kelvin, Chancellor of the University of Glasgow, and for more than fifty years professor of natural philosophy, has bequeathed to the University a legacy of 5000*l*., free of duty, to be applied by the Senate for promoting research and teaching of physical science in connection with the natural philosophy chair. One of the last public acts of the late Chancellor was to preside at the opening, in 1907, by their present Majesties (then Prince and Princess of Wales), of the magnificent Institute of Natural Philosophy, in which the work of the department is now conducted under his successor, Prof. A. Gray, F.R.S. A great variety of valuable researches have been carried out in the department since its opening. In recent months "war work" of a highly important character has occupied the professor and his staff. The Kelvin Foundation will handsomely supplement the existing endowments, provided by the Carnegie trustees and others, for instruction and investigation. A scheme for the application of the bequest is under the consideration of the Senate. Lady Kelvin has also bequeathed to the University all the decorations and medals conferred on the late Lord Kelvin. These will be displayed, with similar personal memorials of Glasgow professors and alumni, in the Hunterian Museum. A collection of historic apparatus, used by Lord Kelvin in his researches, is exhibited in the Natural Philosophy Institute.

LONDON.—Among the public lectures to be given at University College during the term just begun the following are of particular scientific interest:—"The School of Chemistry at University College: Turner, Graham, Williamson, Ramsay," Prof. J. Norman Collie (Tuesday, May 9, at 5 p.m.); "The Manufacture of Nitrates from Air by Electric Power," E. Kilburn Scott (Monday, May 15, at 5.30 p.m.); "The Rôle of Chemical Science in Civilisation," Prof. F. G. Donnan (Tuesday, May 16, at 5 p.m.). All these lectures are open to the public without fee. Admission to the lectures by Prof. Collie and Prof. Donnan will be by ticket only. Applications for tickets, which should state the name and address of each person for whom a ticket is required, should be sent to the secretary, University College, Gower Street, W.C. A stamped addressed envelope should be enclosed with each application.

A special course on spectroscopy will be given at University College by Dr. S. Judd Lewis. The course will have reference to the requirements of chemical investigation and of industrial processes. It will occupy twelve half-days, and will begin on Friday, May 5, at 3 p.m.

THE Right Hon. J. F. Cheetham, of Eastwood, Stalybridge, Cheshire, who died on February 25, leaving estate of the value of 554,276*l*., bequeathed 1000*l*. to the Victoria University of Manchester, and the woodland adjoining Eastwood to his executors to be devoted and set apart as a sanctuary or reserve for the fauna and flora of the district.

THE subject for the Jacksonian prize of the Royal College of Surgeons of England for the present year is "Methods and Results of Transplantation of Bone in the Repair of Defects caused by Injury or Disease," and that for 1917 is "The Causation, Diagnosis, and Treatment of Traumatic Aneurysm, including Arterio-Venous Aneurysm." The dissertation for the 1916 prize must reach the college by Saturday, December 30 next. The triennial prize, consisting of the John Hunter medal in gold, or of the medal in bronze, with an honorarium of 50*l*., will be awarded in 1918, and the subject for it will be "The Development of the Hip-Joint and the Knee-Joint of Man."

THE conference of the National Union of Teachers was held this year at Buxton. The president, Mr. C. W. Crook, delivered his address on April 26. Speaking of education after the war, he maintained that in the curriculum of elementary schools there will undoubtedly be an increase in the amount of time devoted to the elements of science. Woodwork and its concomitant subjects have done much, he said, to relieve our elementary schools from the danger of becoming too theoretical and literary, but these themselves are not sufficient to meet the call for more scien-

tific teaching. Personally, Mr. Crook thinks, there should be a practical room in every school, and that the elements of the physical sciences should be learnt from experiments performed by the children themselves. We must, however, he continued, take care that practical science does not become too dominant in our primary schools. What is needed is the scientific spirit, which should, and must, direct the teaching of all subjects, not omitting the essentials of formal English, so that our children may proceed to sound judgments by accurate reasoning upon clearly viewed facts. The difficulty will be to determine exactly which sciences shall be attempted. Much of the so-called nature-study now attempted gets no further scientifically than the stage of classification, and is rather destructive of nature than instructive in scientific principles. To secure this extension or addition of scientific teaching the requisite time can be found in two ways: first, by the scrapping of some of the subjects or parts of the subjects now taught, and secondly, by the extension of the school age to fifteen. On the former of these two, it must be obvious to all that it is now more than ever necessary that our antiquated system of weights and measures should go, and that some simplification of our spelling and handwriting should, at least, be considered. The number of rules still taught in arithmetic could easily and with advantage be curtailed, and long and useless mechanical problems should be omitted.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, March 24.—Prof. C. Vernon Boys, president, in the chair.—D. **Owen**: The laws of variation of resistance with voltage at a rectifying contact of two solid conductors, with application to the electric wave detector. The paper contains an account of an investigation the primary object of which was to determine the nature of the physical actions occurring at a rectifying contact. Resistance characteristics are given for various contacts, some including a mineral, some in which both elements are metals. It is shown that a specific characteristic may be drawn for any given pair of materials. The experimental results are in accordance with the view that the actions are thermo-electric, the main determining factors being the thermo-electric power and the temperature-coefficient of electric resistance. Based on the law of constancy of the voltage-coefficient, calculations are given showing the best value of the resistance of the telephone in a wireless receiving circuit in which the contact detector is employed. The influence of a polarising voltage is also traced. The use of the combination of rectifier with a direct-current galvanometer as indicator of the balance point in an alternating-current bridge is examined, and it is shown that the minimum detectable alternating voltage cannot be reduced much below a millivolt.—Dr. T. **Barratt**: The electrical capacity of gold-leaf electroscopes. A gold-leaf electroscope is frequently used to compare exceedingly small ionisation currents. For this purpose it is much more sensitive than a quadrant electrometer. If the capacity of the electroscope is known, then the absolute value in amperes of the ionisation current can be deduced. A method is described for measuring the capacity of a gold-leaf electroscope, the method depending on sharing the charge of a parallel plate air condenser of measurable capacity as many times as necessary, and deducing the capacity of the electroscope from the observed drop of potential. The method gives consistent results when the experimental conditions are widely varied. The amount of deflection of the leaf appears to have little influence on the result.

Zoological Society, April 18.—Dr. S. F. Harmer, vice-president, in the chair.—Major H. M. **Evans**: The poison organ of the sting-ray (*Trygon pastinaca*). It has been observed for centuries that the wounds produced by the serrated spine growing from the base of the whip-like tail of the sting-ray produced very severe injuries and pain and inflammation, which could not be accounted for by the laceration of the wounds alone. Dr. Antonio Porta in 1905 described a gland in the groove lying medially to the rows of teeth on either side, which he stated is similar to the gland found in Scorpæna. Major Evans's researches do not confirm Porta's description in all particulars. The examination of a series of sections shows a gland of a different type from that found in the weevers, Scorpæna, etc. The points emphasised are:—(i) The origin of the gland from a special epithelial structure at the base of the spine; (ii) the arrangement of follicles discharging their secretion by ducts or canals, communicating with the exterior by means of nipples or filaments; (iii) the arrangement of these nipples at the base of the teeth; (iv) the presence of muscular fibres surrounding the main canals, which are instrumental in discharging the venom.—R. I. **Pocock**: The external characters of the mongooses (Mungotidæ). The paper dealt principally with the ears, feet, and anal sac. Reasons were given for restoring the generic names Ariela for *Crossarchus fasciatus* and Atilax for *Mungos paludinosus*. It was also shown that the mongooses differ from other Viverridæ in the structure of the ears, and that the type of ear in Suricata is different from that of all other genera of the family.

PARIS.

Academy of Sciences, April 17.—M. Camille Jordan in the chair.—The president announced the death of M. Jules Gosselet, non-resident member, and M. A. Lacroix gave an account of his life work.—G. **Lemoine**: The catalysis of hydrogen peroxide in a heterogeneous medium. First part: general considerations, experiments with mercury. The catalysis of hydrogen peroxide is a surface phenomenon, since it proceeds with rapidity in contact with a layer of silver only 0·0002 mm. thick. A repetition of Bredig's experiments with strong solutions of the peroxide showed that a red oxide of mercury is temporarily formed. Yellow mercuric oxide and hydrogen peroxide react with violence, giving mercury and water with an intermediate production of the suboxide of mercury.—A. **Blondel**: The limiting perception of light signals produced by rotating beams of small divergence, and an apparatus for the comparison of the brilliancy of light of short duration giving the same quantity of light in different times.—M. Yersin was elected a correspondant for the section of medicine and surgery in succession to the late Ernst von Leydn.—H. **Arctowski**: The influence of the earth on the frequency and the mean heliographic latitude of sun-spots. References are given to earlier work on this subject, and the problem reconsidered on the basis of the data of A. Wolfer for the years 1852 to 1913, and of the Greenwich observations. The diagram from the averages illustrates the annual variation of the mean latitude of the spots, and shows that the amplitude of this variation amounts to at least 4°.—M. de **Broglie**: The highly penetrating radiations belonging to the K series of tungsten and the spectra of the X-rays of the heavy metals. The tungsten antikathode spectrum of tungsten in the Coolidge tube, using a rotating crystal of sodium chloride, contains a group with wave-lengths $2.032 \cdot 10^{-9}$. cm. and $1.768 \cdot 10^{-9}$ cm. These radiations are the most penetrating yet discovered as emitted by X-ray bulbs.—V. **Dauzère**: The formation of a cellular network during

crystallisation. A cellular network is formed by fused sodium nitrate, showing close analogy with the similar network described by Cartaud as present in certain rapidly solidified metals.—E. **Fleury**: The ancient glaciations of the Serra da Estrella (Portugal).—C. **Sauvageau**: The gametophytes in *L. flexicaulis* and *L. saccharina*.—R. **Anthony**: A brain of a fœtus of a chimpanzee. A detailed description and comparison with the adult brain and with the brain of a human fœtus of seven to eight months.—E. **Bataillon**: The *rôle* of sodium and potassium salts in polyspermia in Batrachians.—Em. **Bourquelot** and A. **Aubry**: The biochemical synthesis of a galactoside of saligenin, β-salicylgalactoside.—J. **Bergonié**: Illusory protection against the X-rays in doctors already affected. Physical or indirect anaphylaxy. A medical man who, as a consequence of grave radiodermatitis, had given up all X-ray work, was recently under the necessity of again working with X-rays. His skin proved to be abnormally sensitive, a dose 1/1600th of that required to give a reaction with a normal skin sufficing to produce grave symptoms. The nature of these absolutely excluded the possibility of suggestion, and the case might be described as one of physical anaphylaxy.—C. **Richet**: Remarks on the preceding communication. It is pointed out that although the anaphylaxy in this case is the consequence of a physical action, the cause is really chemical, since the X-rays have determined an alteration in the tissues, which is translated by a chemical modification of these tissues or their secretions.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 3, vol. ii., March 1916).—S. **Paige**: The mechanics of intrusion of the Black Hills (S.D.) pre-Cambrian granite.—C. A. **Davis**: The fossil Algæ of the petroleum-yielding shales of the Green River formation of Colorado and Utah. Scientific, as well as economic, interest has been aroused in these shales because they have recently been discovered to yield petroleum when subjected to destructive distillation in closed retorts. The author finds that these shales may be examined microscopically by the methods of sectioning already in use for peats and coals.—A. V. **Kidder**: Archæological explorations at Pecos, New Mexico. The most important results are stratographical, various styles of pottery being found in superposition.—W. **Hough**: Man and metals. An account is given of the author's study of the uses of fire by man in so far as the development of metallurgy is concerned.—W. W. **Campbell** and J. H. **Moore**: The observed rotations of a planetary nebula. The nebula No. 7009 of Dreyer's New General Catalogue is rotating about an axis through the central nucleus nearly at right angles to the plane passing through the observer and the major axis of the image. The mass of the nebula is apparently several times larger than that of the sun. It is suggested that the ring nebulæ are not true rings, but ellipsoidal shells.—H. **Shapley**: A short-period Cepheid with variable spectrum. The star RR Lyræ is a periodic variable in at least three ways: first, in the light of intensity; secondly, in the radial velocity; and thirdly, in the spectrum which changes from F to A. A similar spectral change is found in RS Boötis.—W. S. **Adams** and H. **Shapley**: The spectrum of δ Cephei. At maximum the high-temperature lines are very strong, and the low-temperature lines very weak, while at minimum the reverse is the case. This indicates that at maximum the temperature of the gases constituting the star's absorbing envelope is higher than at minimum.—W. S. **Adams**: Investigations in stellar spectroscopy. I.—A quantitative method of classifying stellar spectra. Method replaces to a considerable extent direct estimations of spectral type by numerical estimates of relative line-intensity, which may be made with much higher accuracy.—W. S. **Adams**: II.—A spectroscopic method of determining stellar parallaxes. III.—Application of a spectroscopic method of determining stellar distances to stars of measured parallax. The method of computing absolute magnitudes and parallaxes from the variation of the intensities of lines in the stellar spectrum is capable of yielding results of a very considerable degree of accuracy.—W. S. **Adams**: IV.—Spectroscopic evidence for the existence of two classes of M type stars. Two groups of M stars are indicated clearly by examination of the intensities of the hydrogen lines.—A. E. **Jenks**: The failure and revival of the process of pigmentation in the human skin. It is found that, on the one hand, there is an extension of the albinistic areas, and on the other a revival of the process of pigment metabolism within an at-one-time albinistic area.—R. W. **Sayles**: Banded glacial slates of Permo-Carboniferous age, showing possible seasonal variations in deposition. A study of the slate and tillite formations of Squantum (near Boston) affords evidence of seasonal changes in the locality, indicating that it was in a temperate zone during Permian times as now.—F. **Morley**: An extension of Feuerbach's theorem. All circular line-cubics on the joins of four orthocentric points touch the Feuerbach circle.—L. P. **Eisenhart**: Deformations of transformations of Ribaucour.—W. W. **Atwood** and K. F. **Mather**: Geographic history of the San Juan Mountains since the close of the Mesozoic era. The study of the geography of this region is closely related to the geologic studies of the range, but may lead also to a study of anthropogeography.—W. B. **Clark**, E. W. **Berry**, and J. A. **Gardner**: The age of the Middle Atlantic coast Upper Cretaceous deposits. The several Upper Cretaceous formations of the Middle Atlantic coast represent all the major divisions of the European series.—Edward W. **Berry**: Upper Cretaceous floras of the world. The stratigraphic position of the more important of the Upper Cretaceous floras is indicated by a diagram.—S. O. **Mast** and F. M. **Root**: Observations on Amœba feeding on Infusoria, and their bearing on the surface tension theory. Surface tension is probably only a small factor in the process of feeding in Amœba.—R. C. **Tolman** and T. D. **Stewart**: The electromotive force produced by the acceleration of metals. Successful attempts have been made to change the relative position of positive and negative electricity in a piece of metal by subjecting it to a large retardation.

BOOKS RECEIVED.

Department of Commerce. Geodesy. Serial No. 7: Latitude Observations with Photographic Zenith Tube at Gaithersburg, M.D. By Dr. F. E. Ross. Special Publication, No. 27. Pp. 127 and plates A to Q. Serial No. 14: Triangulation in West Virginia, Ohio, Kentucky, Indiana, Illinois, and Missouri. By A. L. Baldwin. Special Publication, No. 30. Pp. 67. Serial No. 15: Triangulation along the Columbia River and the Coasts of Oregon and Northern California. By C. A. Mourhess. Special Publication, No. 31. Pp. 149. (Washington: Government Printing Office.)

The Nemesis of Docility: a Study of German Character. By E. Holmes. Pp. vii+264. (London: Constable and Co., Ltd.) 4*s*. 6*d*. net.

The Marketing of Farm Products. By Prof. L. D. H. Weld. Pp. xiv+483. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

The Standard Cyclopedia of Horticulture. By L. H. Bailey. Vol. iii. Pp. v+1201 to 1760. Vol. iv. Pp. v+1761 to 2421. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) Each 25s. net.

Wye Salmon: Results of Scale-Reading, 1908–1915. By J. A. Hutton. Pp. 24. (Manchester: Sherratt and Hughes.)

British Museum (Natural History). British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. i., No. 4: Larval and Post-Larval Fishes. By C. Tate Regan. Pp. 125–155. Zoology. Vol. ii. No. 6: Myzostomida. By Dr. C. L. Boulenger. Pp. 135–140+1 plate. (London: British Museum (Natural History); Longmans and Co.) 9s. and 1s. respectively.

A Class-Book of Chemistry. By G. C. Donington. Part iv. Metals. Pp. vii+401–534. (London: Macmillan and Co., Ltd.) 2s.

Diseases of Poultry: their Etiology, Diagnosis, Treatment, and Prevention. By R. Pearl, F. M. Surface, and M. R. Curtis. Pp. xi+342. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

Publications of the U.S. Naval Observatory. Second series. Vol. ix. (in four parts, with appendix). Part ii. Pp. iii+B. vii+B. 759. (Washington: Government Printing Office.)

Memoirs of the Indian Meteorological Department. Vol. xxi., part xiii.: On the Calcutta Standard Barometer. By E. P. Harrison. (Calcutta: Government Printing.)

The Pathology of Tumours. By Dr. E. H. Kettle. Pp. viii+224. (London: H. K. Lewis and Co., Ltd.) 10s. 6d. net.

Madras Government Museum. The Foote Collection of Indian Prehistoric and Protohistoric Antiquities: Notes on their Ages and Distribution. By R. B. Foote. Pp. xv+246+plates 64. (Madras: Superintendent Government Press.) 14s. 8d.

DIARY OF SOCIETIES.

THURSDAY, MAY 4.

ROYAL INSTITUTION, at 3.—Flints and Flint Implements: Sir Ray Lankester.

IRON AND STEEL INSTITUTE, at 10.30.—Presidential Address. *Papers*: Notes on the Theory of the Corrosion of Steel: L. Aitchison.—Notes on the Relations between the Cutting Efficiencies of Tool Steels and their Brinell or Scleroscope Hardnesses: Prof. J. O. Arnold.—A New Thermo-Electric Method of Studying Allotropic Changes in Iron or other Metals: Dr. C. Benedicks.—Initial Temperature and Critical Cooling Velocities of a Chromium Steel: Dr. C. A. Edwards.—The Influence of Carbon and Manganese upon the Corrosion of Iron and Steel: Sir Robert Hadfield and Dr. J. N. Friend.—Early Experiments on the Recalescence of Iron and Steel: A. Mallock.—A Few Experiments on the Hardness Testing of Mild Steel: W. N. Thomas.—Surface Tension Effects in the Inter-crystalline Cement in Metals and the Elastic Limit: F. C. Thompson.

LINNEAN SOCIETY, at 5.—The Origin of the Garden Red Currant: E. A. Bunyard.—The Dispersal of Organisms, as Illustrated by the Floras of Ceylon and New Zealand: Dr. J. C. Willis.—A Study of the Rectal Breathing Apparatus in the Larvæ of the Anisopterid Dragonflies: R. J. Tillyard.—Description of a New Species of Idotea (Isopoda) from the Sea of Marmora: W. E. Collinge.

INSTITUTE OF METALS, at 8.30.—Sixth May Lecture: X-Rays and Crystal Structure, with Special Reference to Certain Metals: Prof. W. H. Bragg.

FRIDAY, MAY 5.

ROYAL INSTITUTION, at 5.30.—Electrical Methods in Surgical Advance: Sir J. Mackenzie Davidson.

IRON AND STEEL INSTITUTE, at 10.—(See above.)

GEOLOGISTS' ASSOCIATION, at 7.30.—Field Notes on the Faunal Succession in the Lower Carboniferous Rocks of Westmorland and North Lancashire: Prof. E. J. Garwood.

SATURDAY, MAY 6.

ROYAL INSTITUTION, at 3.—X-Rays and Crystals: Prof. W. H. Bragg.

MONDAY, MAY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Travels in Ecuador: Jordan H. Stabler.

ROYAL SOCIETY OF ARTS, at 4.30.—Vibrations, Waves, and Resonance: Dr. J. Erskine-Murray.

TUESDAY, MAY 9.

ROYAL INSTITUTION, at 3.—Chinese Painting: L. Binyon.

ZOOLOGICAL SOCIETY, at 5.30.—A Small Collection of Vertebrate Remains from the Har Dalam Cavern, Malta, with Note on a New Species of the Genus Cygnus: Miss Dorothea M. A. Bate.—An Experimental Determination of the Factors which cause Patterns to appear Conspicuous in Nature: Dr. J. C. Mottram.

ILLUMINATING ENGINEERING SOCIETY, at 5.—Annual Meeting, followed by a Discussion on a Report to be presented by the Research Committee.

FARADAY SOCIETY, at 8.—An Analysis of the Theory of Gels as Systems of Two Liquid Phases: E. Hatschek.—(1) The Properties of Solid Solutions of Metals and of Intermetallic Compounds; (2) The Annealing of Metals: F. C. Thompson.—The Changes in the Physical Properties of Aluminium with Mechanical Work. II. Specific Heats of Hard and Soft Aluminium: F. J. Brislee.—A Note on the Annealing of Aluminium: R. Seligman and P. Williams.—Grain Size Measurements and Importance of such Information: Z. Jeffries.—A Contribution to the Theory of Solution: E. J. Hartung.

WEDNESDAY, MAY 10.

GEOLOGICAL SOCIETY, at 5.30.—Carboniferous Fossils from Siam: Dr. F. R. Cowper Reed.—The Lurgecombe Mill Lamprophyre and its Intrusions: H. G. Smith.

OPTICAL SOCIETY, at 8.—Apparatus used for the Teaching of Optics at the Cavendish Laboratory, Cambridge: Dr. G. F. C. Searle.

THURSDAY, MAY 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Seventh Memoir on the Partition of Numbers. A Detailed Study of the Enumeration of the Partitions of Multipartite Numbers: Major P. A. MacMahon.—The Occurrence of Gelatinous Spicules and their Mode of Origin in a New Genus of Siliceous Sponges: Prof. A. Dendy.—The Classification of the Reptilia: E. S. Goodrich.—The Experimental Production of Congenital Goitre: Dr. R. McCarrison.

ROYAL INSTITUTION, at 3.—Flint and Flint Implements: Sir Ray Lankester.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—*Discussion*: The Influence of the War on the Mining and Metallurgical Industries.

FRIDAY, MAY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—The Latent Heats of Fusion of Metals and the Quantum Theory: Dr. H. S. Allen.—(1) Lenses for Light Distribution; (2) The Choice of Glass for Cemented Objectives: T. Smith.

MALACOLOGICAL SOCIETY, at 7.—Descriptions of New Mollusca: G. B. Sowerby.—Solander as a Conchologist: T. Iredale.—Misnamed Tasmanian Chitons: T. Iredale and W. L. May.

SATURDAY, MAY 13.

ROYAL INSTITUTION, at 3.—X-Rays and Crystals: Prof. W. H. Bragg.

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THURSDAY, MAY 11, 1916.

HARVEY AND ARISTOTLE.

Harvey's Views on the Use of the Circulation of the Blood. By Prof. J. G. Curtis. Pp. xi+194. (New York: Columbia University Press; London: Oxford University Press, 1915.) Price 6*s*. 6*d*. net.

UNPRETENDING as it is, this is an admirable little book. It is concise but full of matter, is scholarly and accurate, and, for those who concern themselves with the history of ideas, very interesting. It is a curious thing that of the scores of orators on Harvey none has given any considerable place to a closer discussion of the relations of Harvey to Aristotle and to Galen. Some of us have touched upon the attitude of Harvey towards the overbearing tradition of these two great ancients, and of the degree, or terms, in which he doggedly asserted his independence of it, or in which he admitted their doctrines or approved their speculations; but no one seems to have completed the task of setting forth exactly how far the ideas, let us say, especially of Aristotle and of Harvey, coincided or diverged. This Prof. Curtis has done, and done finally. Unhappily, upon the appreciation of the reviewer there lies a shadow: this able and interesting scholar died, in September 1913, before the publication of his work. At the author's request, this volume has been edited by his colleague, Frederic Lee, of Columbia University.

Prof. Curtis considers first the attitude of Harvey towards the question of the uses of the alleged circulation of the blood. Why, said not only his opponents but also the master himself, why, if the blood is but a nutrient fluid, need it be scampering in every second of time all round the mammalian frame! Here Harvey was himself a little puzzled; about the respiratory functions and the nature of combustion he was, if I may venture to say so, somewhat less far-seeing than had been some of his remote forerunners, or even Columbus. Unfortunately, he abhorred chemists, seeing, no doubt, very unfavourable examples of the craft. With the supposed cooling effect of the pulmonary ventilation Harvey remained fairly content. The redness of the arterial blood he attributed to a filtering effect of the lungs.

Another principal chapter of Prof. Curtis's history is, of course, concerned with the well-known Aristotelian primacy of the heart. This hegemony Harvey ardently contested; only to put in its place the primacy of the blood. Aristotle's cardiac primacy connoted far more than Harvey dealt with, but, narrowly speaking, when Harvey makes the blood the seat of the Innate Heat—not to mention the soul—and speaks of innate heat as an entity, and, furthermore, as an uncaused entity, it is not apparent that Harvey's view was more far-seeing than Aristotle's. Whether the heart heats the blood, or the blood possesses heat as an innate quality, scarcely seems to us, nowadays, to demand much discussion. Were Prof. Curtis still with us one might have asked of him if the truth were not that the ascendant genius of both these great men was not as philosophers, but as observers. Imagination was not the strength of either of them. Like Aristotle, Harvey, in speculative genius, was surpassed by many of his predecessors and contemporaries. The great Ionian thinkers were full of wonder, as well they might be, whence and how came motion. But this problem did not trouble Harvey overmuch; as an observer he recognised the activity of the circulation, as he saw it, from the *punctum saliens* to the human heart; and when the problem of its origin became pressing he was fain to follow Aristotle, and to find it akin to the quintessence—the motive principle of the stars. The circulation of the blood was one of the subordinate tides of the circulation of the heavens. As regards the heart itself Harvey was no mystic; the blood was the potential, the heart he reduced almost to a muscular pump. But he had no lively idea of the circulation as a hydrostatic and hydraulic mechanism, and, perhaps, before Torricelli and Hales, could not have had.

One may, with all respect, hesitate to be sure that Prof. Curtis was familiar with the pre-Aristotelian thinkers, and the commentaries upon them of Diels, Wellmann, Gomperz, and others. Zeller, indeed, he does mention in one place. It is not altogether reassuring to be referred once or twice to Cicero as a source of our knowledge of their conceptions. From Harvey to Aristotle we are carried back on sound learning, but there, as at a sort of butt end, we stop. The author may have decided, of course, that these were to be the limits of his volume, and properly kept to them. But the history of the circulation cannot be dealt with historically without a wider survey of the doctrine, and beyond the doctrines the ideas, of the pneuma, and of what I have called elsewhere the pathetic quest after oxygen, than he had allowed himself to undertake. That elusive stuff "between air and fire," so keenly apprehended by the Ionians and repeated by Galen, is scarcely congenial to Harvey, or, indeed, to Aristotle. Harvey declared that the "innate heat" was not akin to fire, which he said was a sterilising agent; he was probably unaware of the profound and ancient distinction between fire in its capacity as an artificer and as a destroyer.

It is tantalising, under the restriction of present limits, to bring the review of this remarkable book to an end with so inadequate a discussion of the principles discussed in it, and with no note of the many particulars on which one would gladly have tarried. The notes of reference to quotations are constant and accurate; would they had been, or most of them, footnotes. Incessantly to be turning to and fro between the text and an appendix is a nuisance.

CLIFFORD ALLBUTT.

THE FRESH-WATER FISHES OF AFRICA.

Catalogue of the Fresh-water Fishes of Africa in the British Museum (Natural History). Vol. iv. By Dr. G. A. Boulenger. Pp. xxvii+392. (London: British Museum (Natural History), and Longmans, Green and Co., 1916.) Price 30*s*.

THE British Museum has recently published the fourth volume of Mr. G. A. Boulenger's "Catalogue of the Fresh-water Fishes of Africa." Thus is brought to a conclusion—at any rate, for some years to come—a work of very great value. Mr. Boulenger's research into the ichthyology of the African rivers and lakes has gone far beyond a mere catalogue of species. It began to attract attention nearly twelve years ago by the light that it threw on the past geological history of Africa, the former superficies of this continent at different times in regard to rising and falling levels of land, the connections of the continent with outlying islands, the desiccation or the flooding of great areas of land in the interior, the increase or the restriction of river basins and of lake limits. Briefly summarised, it went to show that the Nile system in past times has been in direct communication with the now isolated Lake Rudolf, and has come very near to the Chad Basin, which again has communicated intermittently with the Niger, while the Niger or its upper portion may at one time have had an outlet into the Atlantic in common with the Senegal, and have been separable by only a few miles of land from the upper waters of the Gambia, the Volta, and of all those streams that flow from north to south through the forests of Guinea and the Gold Coast into the great African Bight. On the other hand, it showed a comparative poverty and isolation in fish fauna of the Zambezi Basin and South Africa; and it illustrated, above all, the specialised character and wealth in fish-fauna of the Congo Basin. This region (with which Tanganyika was not always connected) must have approached very closely to the upper waters of the Gaboon and Cameroons rivers to account for the near relationship between their fish-fauna and that of the Congo Basin.

So far back as 1870, Dr. Günther, of the British Museum, could only catalogue about 255 species of African fresh-water fish. Mr. Boulenger raised this number in 1906 to 974; but he is enabled in the volume now under review to put the total of species at 1425.

In this amazingly complete survey of African fishes he has been helped by many enthusiastic collectors and students, and directly or indirectly by the Belgian, French, and Luxembourg Governments, as well as by those of Egypt and the Union of South Africa. Volume iv. of this magistral work deals with the fresh-water Gobies, the Anabantids or "climbing perch," the Mugilids or Mullets, the Blennies, the Mastacembelids (anguine in form, and so often taken by negroes to be water snakes because many of them are handsomely marked with viperine patterns), and the Tetrodonts. In addition, there is matter supplementary to the other volumes, which gives us further information in regard to the presence of "saw fish" sharks (Pristis) in the rivers of Portuguese Guinea; additional knowledge of the Polypterids of Portuguese Guinea and Liberia, and of that very interesting aberrant type, the Calamichthys of Calabar; of the Mormyrids of the Juba River (Somaliland) and of Portuguese Guinea, Northern Zambezia, the Upper Wele, Lake Bangweulu, and the Lower Niger; of the fresh-water herrings of Angola, the Characinids of western Congoland and Portuguese Guinea, Cyprinids from all parts of Africa, including the far south, and Silurids of an equally wide scope. (It is interesting to note, by the way, that there is a species of fish—*Salarias*, a Blenny—shared between Madagascar and Réunion Island.)

A tribute is justly paid by Mr. Boulenger to the magnificent collecting work accomplished by the late Dr. W. J. Ansorge, who, after exploring Uganda and other parts of Africa in the medical service of the British Government, devoted himself, on his retirement, to a systematic examination of the fish (and other) fauna of Portuguese West Africa, especially Angola and the little-known Portuguese Guinea. It is to be hoped that men like these, who have died in the prosecution of really noteworthy scientific research, might be commemorated by tablets let into the walls of the British Museum of Natural History.

H. H. JOHNSTON.

THEORETICAL AND PRACTICAL CHEMISTRY.

(1) *The Theory of Valency.* By Dr. J. Newton Friend. Second edition. Pp. xiv+192. (London: Longmans, Green and Co., 1915.) Price 5*s*. net.

(2) *Qualitative and Volumetric Analysis.* By W. M. Hooton. Pp. 86. (London: Edward Arnold, 1915.) Price 3*s*. net.

(3) *Laboratory Manual arranged to accompany "A Course in General Chemistry."* By Profs. W. McPherson and W. E. Henderson. Pp. v+141. (Boston and London: Ginn and Co., 1915.) Price 3*s*.

(4) *The Rugby Course of Elementary Chemistry.* By H. P. Highton. Pp. 79. (London: Edward Arnold, 1915.) Price 2*s*. 6*d*.

(1) THE perusal of a treatise on valency leaves an impression of incompleteness and uncertainty, of a mass of theories no single one of which can claim to correlate and interpret more than a portion of the relevant facts. This aspect of the matter, to which reference was made in the review of the first edition of Dr. Friend's excellent volume (NATURE, 1909, lxxx., p. 395), has been accentuated by recent work on radioactivity, and the modified views with regard to chemical combination and valency to which this work has led. The author, although fully aware of the extent to which earlier conceptions are undergoing change, points out that nothing like finality has been reached. He therefore does not

attempt in the present volume any full discussion of the latest views, and merely indicates the main lines along which progress is being made. This is a wise decision.

The chapter on "Exceptions to the Periodic Law" has been enlarged by a brief consideration of the valency of the metals of the rare earths, and their position in the periodic table, as well as by a short discussion of the radio-elements and the existence of isotopes. The exposition of Werner's theory given in the first edition has been amplified by an account of Ephraim's work, the results of which have shown that on the whole the strength of the auxiliary valencies falls as the atomic volume of the metal concerned increases. In this connection reference is made to Werner's recent conclusion that there is no essential difference between principal and auxiliary valencies.

Some theories of valency, such as those of Werner, and of Barlow and Pope, postulate the existence of certain forces, and on this basis attempt to formulate the constitution of the molecule. Others, more definitely physical in character, deal with the *origin* of the forces postulated by the chemist, and are therefore affected by any alteration in the views held as to the structure of the atom. These considerations have led the author to devote a few additional pages to the electronic theory of valency, as this has developed in the light of modern work by Rutherford, Bohr, van den Broek, Moseley, Falk, and Thomson. It will be interesting to see how far the conclusions based on this work, as, for example, the assigning of a valency of two to hydrogen and the consequent doubling of the valency numbers of all other elements, will command general acceptance.

(2) The compilation of tests and the tabulation of methods for qualitative inorganic analysis which mainly constitute the first part of this volume are sound enough, but except for slight differences in the arrangement of the matter and in the general get-up, the thing has been done scores of times already. True, the reactions of some of the less common metals and acids are also described, but this scarcely constitutes such a claim to originality as would justify publication.

The second part contains quite a useful selection of exercises in volumetric analysis, and the explanations and directions given are on the whole satisfactory. The relation, however, between the general definition of a normal solution and its interpretation in the case of oxidisers might be put more clearly. Further, in connection with the use of potassium dichromate, the student might legitimately be puzzled by the statement on p. 74 that "a standard solution is made by dissolving a known weight of pure dry $K_2Cr_2O_7$ in distilled water, and its exact strength can be determined by titrating it against a known weight of pure iron in the ferrous state." The author himself, on the following page, points out that the strength of a solution of potassium dichromate, prepared by dissolving a known weight of the pure dry salt and then making up to one litre, is known exactly.

(3) The authors of this first year college laboratory manual, almost conscious that some apology is required for an addition to the large number of such books already on the market, state in the preface that the volume lays no claim to originality, either in method or in content. All that has been done is to select the exercises which the beginner should undertake. It is really time to protest against this unlimited production of elementary laboratory guides, and to point out again the absurdity of the implied claim that slight differences in the character of the experiments proposed and in the order of their arrangement are of such paramount importance. Why not leave something to the judgment and initiative of the teacher?

The arrangement of the experiments suggested by the authors invites criticism. For example, the most elementary examination of the characteristics of acids, bases, and salts is preceded by a chapter in which work is proposed on fractional distillation, protective colloids, and the colour of ions and molecules. Again, the student's attention is not specifically directed to the production and properties of carbon dioxide until more than half the course has been covered.

Even the hints given in the appendix for the benefit of the instructor are not entirely satisfactory. The direction to prepare dilute sulphuric acid by diluting the concentrated acid in the ratio 1 : 4 is a case in point: a 30 per cent. solution of this acid should not be employed as a dilute reagent.

Altogether, it may be said that in a badly-managed or poorly staffed laboratory the volume under review might be useful as a guide, but that for the student in an institution where competent teaching is available the best hint is that given on p. 75—"report to the instructor for quiz on the methods."

(4) The views expressed above as to the scant justification for adding to the number of introductory laboratory manuals are in some measure applicable to this case also. If the "Rugby" variety of elementary chemistry course is to be put before us, why not many others as well, which may have quite as good a claim to publicity? At the same time it may be admitted that this volume, which is intended to cover a period of two school years, contains evidences of originality in the way of suggestive experiments and in the devising of simple apparatus for carrying them out. The course on which the book is based is clearly characterised by thought and initiative on the part of the author and his associates. J. C. P.

OUR BOOKSHELF.

Colour: a Handbook of the Theory of Colour. By G. H. Hurst. Second edition revised. pp. vii + 160. (London: Scott, Greenwood and Son, 1916.) Price 7*s*. 6*d*. net.

THOSE who are interested in colour effects, especially, perhaps, dyers, calico-printers, decorators, students, and, to a lesser degree, artists, will find much useful information in this very

moderate-sized volume. The author deals with the production and cause of colour, phenomena of colour, the eye, effects of contrast, and colour measurement. He quotes largely from the standard works of Chevreul, Rood, and, to a smaller extent, from others. Many useful tables are given with regard to the effects of juxtaposed colours on each other, the illumination of coloured objects by coloured lights, and concerning the colour and luminosity of the solar spectrum. The absorption spectra of about forty of the commonest pigments, dyes, and coloured glasses are shown as curves. There are eleven full-sized coloured plates which illustrate in a striking manner the effects of colour combinations and similar matters, though when the student of colour sees the fourteen absorption spectra that are represented in full colour he will wish that it were possible to get such clean-cut absorptions as the diagrams exhibit.

Although this is a revised edition, there is still room for revision. For example, the reader would imagine from the statement at p. 79 that Thomas Young followed Brewster and Maxwell and criticised their theories. If the starch granules in a Lumiere colour plate were of the size that they are stated to be, the grain would be far too fine to be visible by any microscopical methods; and in this process one does not obtain a negative, and then from this prepare a positive which is "viewed in conjunction with a similar screen." In three-colour printing the negatives are not taken through "red, blue, and yellow screens respectively."

Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam. By Bunzō Hayata. Vol. v., pp. vi+358+xvii plates. (Taihoku: Government of Formosa, 1915.)

THIS fifth volume of the Icones of the Plants of Formosa is devoted especially to new material collected in Formosa since 1912. It is a worthy successor to the previous handsome volumes, and contains studies on 385 species and eight varieties of flowering plants and ferns. The studies are illustrated by seventeen quarto plates and numerous text figures. Two hundred and three of the species are new to science, and twenty-three genera hitherto unrecorded for the island are added to the flora. At present the flora is known to comprise 160 families with 914 genera and 3325 species. One particularly interesting discovery is that of a new species of the ancient fern Archangiopteris, the genus first found by Henry in Yunnan in 1899. The addition of the families Burmanniaceæ and Xyrideæ to the flora of Formosa is also noteworthy. A large number of ferns are dealt with in this volume, the majority belonging to the Polypodiaceæ; one plant called *Polypodium urceolare* may not belong to this genus, as it is considered by some pteridologists to be a subgenus of Davallia. A long discussion of the points at issue is given in the text.

The volume is very well printed and the illustrations are remarkably clear and good.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Science and the State.

IN view of the efforts that are now being made in many quarters to bring about better relations between science and the State, it is interesting to recall Sir David Brewster's dedication of his "Memoirs of Sir Isaac Newton." It is addressed to the Prince Consort, and dated from St. Andrews sixty-one years ago, and yet it is sufficiently suggestive of the circumstances of the present day to be reproduced in full.

To
His Royal Highness
PRINCE ALBERT, K.G.,
Chancellor of the University of Cambridge.

SIR,—In dedicating this Work to your Royal Highness, I seek for it the protection of a name indissolubly associated with the Sciences and the Arts. An account of the Life, Writings, and Discoveries of Sir Isaac Newton might have been appropriately inscribed to the Chancellor of the University of Cambridge, the birth-place of Newton's genius, and the scene of his intellectual achievements; but that illustrious name is more honourably placed beside that of a Prince who has given such an impulse to the Arts and Sciences of England, and whose views, were they seconded by Statesmen willing to extend Education and advance Science, would raise our country to a higher rank than it now holds, among the nations of Europe, in the Arts of Peace and of War. It is from the trenches of Science alone that war can be successfully waged; and it is in its patronage and liberal endowment that nations will find their best and cheapest defence.

That your Royal Highness may be enabled to realise those noble and patriotic views respecting the national encouragement of Science, and the consolidation of our Scientific Institutions, which you have so much at heart, and that you may long live to enjoy the reputation which you have so justly earned, is the ardent wish of

Sir,
Your Royal Highness's
Humble and obedient Servant,
DAVID BREWSTER.

St. Leonard's College,
St. Andrews, May 12, 1855.

The relation of science to the State is referred to on various occasions in the memoirs; and the financial worry, to which the unfortunate illness of the great philosopher in 1692 is attributed, is held up as a black example of national neglect. The project which Brewster favoured was State support for men of science on the lines of the French Academy, and to the lack of such support Brewster attributed the neglect of the Newtonian philosophy in England, while it was being successfully developed in France by Laplace, d'Alembert, Clairaut, and others.

A perusal of the memoirs at the present time carries other lessons. The fierce controversies among the contemporary men of science about priority and plagiarism, which led Newton, time after time, to abjure the society of philosophers, and the factious criticism which they employed, make it clear that, unless they have changed in character, the fullest recognition of men of science by the State will not be exactly the beginning of the millennium; and they change their

character very slowly. Brewster himself uses language about Thomas Young and the undulatory theory which recalls the fact that though a statesman had a great share in it, it was not the State that drummed the greatest philosopher since Newton out of the ranks of science. Something more of regard for the *genus humanum*, the statesman's care, and a little less attention to the *ingenio superavit*, the examiner's business, seem necessary to give science its true position.

Lest I should be thought merely to be indulging in the prevalent habit of "grousing," let me briefly explain. The exponents of science in this country have allowed the issues of the inevitable conflict of studies in science to be dictated everywhere from the examination point of view. That calamity—for it is nothing short of it—is more largely responsible for the apathy of the State towards science than is generally acknowledged.

So far has our control by examination extended that it is not too much to say that, for the general, our education has become the art of passing examinations without having to think, and the educational profession is, in practice, the only human occupation for which a general education is not required.

The difficulty is a real one, but it must be faced; we must find something better to offer, as our idea of education inspired by the study of nature, than 30 per cent. of what is set out in the examination papers put before an individual student in one or other of the alternative courses controlled by men of science. Specialists are, of course, the *corps d'élite* of the army of science, but they ought to be persuaded not to use the nursery as their battleground. That is our business, and we can do it if we will.

NAPIER SHAW.

The Daylight Saving Scheme.

I SHALL be glad if you will allow me to deal with the objections raised to the daylight saving scheme in NATURE of April 27. I have had to content myself with identifying these by the numbers of your paragraphs.

(1) Though people engaged in the trades you mention may not receive the same benefits from the operation of a Daylight Saving Act as in the case of the rest of the population, those at least who are interested in gardening and in any form of athletics would benefit from an extra hour of daylight at the end of their day, and all would effect a saving in artificial light. I have also dealt with this question in my reply to your objection (6). From the fact that these trades regulate their times more by the sun than by the clock, it must at least be granted that they would take no harm from the Act.

(2) If, as seems probable, the daylight saving principle is universally adopted in Europe, there is no reason why there should be any more chaos than at present. It was not proposed to interfere with Greenwich mean time, and that would remain as the universal standard just as it is to-day. Such difficulties as would arise in this respect are only of such a nature as could be got over.

(3) Those places which get twilight all night would not suffer by an alteration of the clock, even though they might not reap any special benefit. A large majority of the population of Great Britain lives in the southern half of the kingdom.

(4) The reason that the proposed date of altering clock time back to Greenwich mean time was fixed for the third week in September was that at the end of the year the atmosphere in the early morning is usually warmer than that which we experience in March and the beginning of April, frosts being practically unknown in September.

(5) I sincerely hope that the intelligence and resource of the gentlemen responsible for these matters are not of such a low order as to be unable to deal with such questions as may arise.

(6) I think that your approximate calculation of the additional darkness which the early-morning workers would experience has failed to take into account the fact that it is light about three-quarters of an hour before sunrise. Very few of those starting work at 6 a.m. would require to use artificial light to rise by. Certainly in September there would be some additional use of light in the morning.

(7) Granting that there would be some additional use of fuel in the morning, you fail to notice that there would be a corresponding saving in the evening.

(8) Nobody appreciates the value of the scientific method more than I do. Might I suggest that the daylight saving scheme is less a question of absolute science than of social and political science? Your principal argument is that it is the scientific men who should decide as to whether or not the provisions of the measure should be adopted, and that they as a body have not expressed their support. The real reason of this is that it is not a question that interests them as a whole in their scientific capacities. All scientific men are interested in time measurement, but they are principally interested in the actual lengths of the units of time, viz., of minutes and hours. Those who have special interest in the relation of clock time to solar time are practically confined to the astronomers, meteorologists, and navigators. Of the five astronomers who have taken up the subject, three were in favour of the Bill. They were the late Sir Robert Ball, Prof. Rambaut, and Prof. Turner. On the other hand, Sir William Christie and the late Sir David Gill opposed the Bill. To anyone who carefully reads the evidence given by these latter gentlemen before the Parliamentary Committee of 1908, it is quite clear that their opposition was based, not on scientific grounds, but merely on grounds of social expediency, and their replies to the questions of the Committee are largely filled with discussions of the habits of shopkeepers, clerks, factory hands, etc., on which subjects scientific eminence is scarcely necessary in order to make one expert. As a matter of fact, Sir William Christie, in replying to the question, "The idea of the Bill is not altogether so unreasonable as it might on the face of it appear?" replied, "No, my view is rather that it does not obtain the greatest convenience. That is really my argument here," etc.

I should scarcely imagine that the rejection of a private Bill by Parliament would be accepted by men of science as a final test of the social value of the measure; however, this is what you suggest to them. In your section No. 7 you make a suggestion as to the reason of our customary time-table. I think really that our time-table has developed to suit the winter light conditions, as such a one is the only single unaltered time-table which is reasonably workable throughout the year.

H. W. M. WILLETT.

Sloane Square, London, S.W., May 2.

[We deal elsewhere in this issue with the main points of Mr. Willett's letter.—EDITOR.]

Avoiding Zeppelins.

A LITTLE knowledge of spherical perspective would materially reduce the loss of life due to Zeppelins. There is no danger from a bomb dropped by one of these vessels unless the latter is approaching the zenith, and will reach there in a few seconds. If the Zeppelin appears inclined—that is, unless one end appears exactly over the other—there is no danger. This is easily seen at a glance, but a plumb-line formed by a stone attached to a string will show this with certainty. The Zeppelin will always pass on the side

towards which the upper end points. If, however, it is vertical, and near the zenith, there is great danger. If its altitude is, for example, a mile, a bomb dropped would occupy 18 seconds in falling, if there were no air. Owing to the resistance of the latter, this time is greatly increased. It is only necessary to run at right angles to the apparent direction of the Zeppelin to be safe, even if one does not start until the bomb is dropped. This rule may be tested by standing under a telephone wire, which may be regarded as representing the path of the Zeppelin. A plumb-line will cover the wire only if the observer is exactly under the wire. No allowance is here made for the wind, which always carries the Zeppelin to leeward. It may be better, therefore, to stand so that the Zeppelin is partially covered by the edge of a house, a flagpole, or other vertical line. There is no danger unless the Zeppelin appears to ascend the line, remaining partially covered as it approaches the zenith. The same principles apply to aeroplanes. At sea, the vessel should take a course at right angles to the direction from which the Zeppelin comes. Of course, these methods are useless if the Zeppelin cannot be seen owing to clouds or darkness, unless it is picked up by a searchlight.

E. C. PICKERING.

April 10.

DAYLIGHT AND DARKNESS.

THE House of Commons adopted on Monday a resolution moved by Sir Henry Norman: "That, in view especially of the economy in fuel and its transport that would be effected by shortening the hours of artificial lighting, this House would welcome a measure for the advancement of clock time by one hour during the summer months of this year." The daylight saving scheme put forward by the late Mr. W. Willett in 1907 has, therefore, now been approved by Parliament, and it is proposed to effect the change of time during the night of Saturday–Sunday, May 20–21. The normal Greenwich time is to be restored during the night of Saturday–Sunday, September 30–October 1. In supporting the motion on behalf of the Government, the Home Secretary, Mr. Herbert Samuel, said it was thought that the change could be effected without legislation by Order in Council, "since this is only a war measure adopted for war purposes." On account, however, of the existence of an Act which defines "hour" in any statute as Greenwich mean time in Great Britain, and Dublin mean time in Ireland, and also because, in conformity with this Act, there are fixed the hours in factories and workshops in which women and children are employed, while a number of other establishments, including licensed houses, are compelled by law to keep certain times, the law must be altered in order that the new time should have legal validity. A Bill is, therefore, necessary, and it was introduced in the House of Commons on Tuesday. There is little doubt that the measure will pass, and that from May 21 to October 1 the legal time will be that of Mid-Europe instead of Greenwich mean time.

The time of sunrise in London on Sunday, May 21, is given in the calendars as 4.2, but by the clocks it will be 5.2; and similarly, though the sun will set at 7.50, we shall call the hour 8.50. The actual time of morning high-water at London Bridge will be 4.12, but the clocks on shore will indicate 5.12; and there will be a like difference between tidal times and public times all around the coast. It will be no longer possible to speak of, say, a two o'clock tide to a navigator at a port, for this must mean Greenwich time to him, as tidal tables have to remain unaltered, whereas his two o'clock will be the landsman's three o'clock. For a large part of the population there will be two legal times from May 21 to October 1, and we shall be surprised if this confusion does not lead to serious mistakes and accidents.

All orders referring to lighting-up times, closing of parks and other places at dusk, burglary as distinct from larceny, and like matters determined by solar time, will need adjustment; in fact, Parliament has now to define legal time afresh. Lighting-up times will, we suppose, continue to be based upon Greenwich times, with the necessary differences for latitude and longitude, for they obviously cannot be determined by the meridian of Mid-Europe. On May 21, for example, the lighting-up time in London is 8.50, and at Liverpool 9.11, but in all cases an hour will have to be added to give the clock times of lighting-up. Here, again, the double standard of time-reckoning—one in calendars and tables, and another in daily use—will be most confusing.

The claims as to the great saving of expenditure on fuel for illumination to be effected by the daylight saving measure are, we believe, largely over-stated. For two months from the end of this month there will be no need for artificial lighting until 9 p.m. or later in any part of the British Isles; and in such places as Newcastle and Glasgow the lighting-up times will be nearer 10 p.m. than 9 p.m. during most of this period. Men of science, like other citizens, recognise the cheapness of using daylight; what they object to is the alteration of clocks, instead of alteration of habits, to induce reasonable use of daylight hours. Whatever time is indicated by the clocks, most people will not retire until an hour or two after the sun has gone and they have used artificial illumination for indoor rest or recreation. Though the clocks will indicate 10.30 when daylight occupations must end during June and July, we doubt greatly whether there will be much reduction of the habitual interval between the close of the outdoor life and the time of retiring.

The daylight saving principle is, in fact, unnecessary for at least half the period during which it is to be in force; and over a large part of the British Isles the hours of actual darkness are then so few that the amount of artificial illumination used cannot be greatly reduced by advancing clocks by one hour. Mr. Willett arrived at the 154 additional hours of daylight which his scheme was to give the country by reckoning an extra hour for each of the 154 days from April 15 to September 15, and our legislators, journalists, and commercial men base their conclusions as to the saving of fuel and light upon this estimate, which they apply to the whole country. If we

omit from the estimate June and July, when the amount of artificial illumination required is very small, and there is no real night, the 154 hours are reduced to 93; and for one-third of this number of days artisans who commence work at 6 a.m. will be given nearly an hour's additional darkness. During the cold and dark morning hours of September we shall expect definite complaints from early workers as to the disadvantages of the scheme to them. If their times are changed to 7 a.m. instead of 6 a.m., they will have to leave an hour later, and the whole purpose of the measure will be defeated.

In a letter to Sir Henry Norman, stating that the Government intended to give facilities for the discussion of his motion on daylight saving, Mr. Herbert Samuel, the Home Secretary, said: "In the House of Commons all interests are represented, and the Government would desire to ascertain its opinion on this question." We submit that the House of Commons is not essentially more competent to discuss the question than it is that of the eccentricity of the earth's orbit or of the obliquity of the ecliptic by which differences in the lengths of days are caused. In the debate in the House on Monday, few points of scientific significance were mentioned, and the matter was considered almost entirely from the point of view of public convenience and the marvellous economy—the amount of which varied with a member's eloquence and calculations—to be effected. It is urged that the views of men of science on social legislation have no greater authority than those of the general public; but, on the other hand, we may be permitted to reply that members of the House of Commons, chambers of commerce, county and borough councils, and like corporations do not understand the scientific aspects of their social measure, and that they, as well as enthusiastic writers in the daily Press, are attracted by a specious plan without regard for its natural significance. By scientific aspects we do not mean the interests of men of science, but the natural conditions of daylight and darkness in different latitudes and longitudes of these islands, and the consequences of a double time-standard. There can be no true discussion of the daylight saving scheme unless this side of the subject is presented as well as the social and economic arguments; and in Monday's debate in the House of Commons, it was left out of account almost entirely.

The fact that Germany has introduced the daylight saving scheme, and has naturally been followed by Austria and Holland, is not a reason why we should adopt it, but the reverse. It is now announced that in Denmark, Sweden, and Norway the same plan is to become effective on May 15 and to extend to September 30, though what advantages the lands of the midnight sun can derive from a daylight saving scheme in summer months are difficult to discover. Germany probably decreed the change of time because we refused to do so, and for us to imitate her now is not complimentary to our national intelligence. The case is different with France, on account of our close relations with that country and because the French time-standard is that of the Greenwich meridian; but the committee of the French Senate appointed to examine the proposal of the Chamber of Deputies has not yet reported in favour of it, and the paper by M. Lallemand of which a summary was given in last week's NATURE adduces cogent reasons against it. As the adoption of Greenwich time by our Ally was a manifestation of the *entente cordiale,* it seems undesirable now to abandon this common standard and use German time unless France wishes to make the change with us.

Most of the foregoing points, with others, were mentioned in an article in NATURE of April 27 referred to by Mr. H. W. M. Willett in a letter which appears in our correspondence columns this week. The intention of the article was to state precisely some of the chief objections to the principle of daylight saving by seasonal changes of the national time-standard. Scientific men think that this standard, like others, should be invariable; advocates of the daylight saving scheme wish the standard to oscillate and to believe that 11 a.m. is noon for five months of the year. Agricultural, engineering, and building trades adapt their hours to the sun, and workers on tidal waters with the tides; but as the tendency of city life is towards lateness of rising and retiring, and as habits are difficult to alter, they are to be counteracted by putting forward the hands of timepieces by one hour during the summer months.

Whether the change may be justified on the grounds of social expediency is not a matter upon which men of science can express an authoritative opinion; but the natural objections and difficulties remain unaltered whatever legislative action is taken. To the fact that for a large part of the population of our islands the daylight saving principle is unnecessary, Mr. Willett's reply that they would not suffer is scarcely sufficient justification for the change. He offers no solution of the difficulties as regards the differences of times in calendars and tide-tables in comparison with the altered civil times, though in a maritime nation such as ours this is a most important point. As to artisans who have to be in the works at 6 a.m., and therefore to rise about 5 a.m., Mr. Willett will find that when longitude is considered, as well as the period of dawn, many thousands of workers will, throughout September, on account of having to rise at what is 4 a.m. Greenwich time, have to rise in the dark instead of in daylight as hitherto. If fuel and light saved in the evening are used in the morning, it is difficult to see how substantial economy can be gained in these cases.

A scientific journal is not concerned with the expediency of a measure, and the facts of Nature are, of course, not affected by social legislation. Whether men of science support or oppose the daylight saving scheme may be of little conse-

quence; but they are, at any rate, best able to understand its meaning, and to distinguish between promise and performance. It remains for the general public to arrive at the same state of knowledge by experience.

GERMAN METALLURGY AND BRITISH METHODS.

MUCH attention has been devoted in the Press recently to the strong position of the German metallurgical industries, both before the war, and now after a year and three-quarters of stress. It is not too much to say that apart from this metallurgical industrial foundation, the war would have ended in three months. The growth of modern German metallurgy is due largely to two causes, and these are closely connected in origin and result. They are trade combinations, such as are represented by the "Stahlwerksverband," and scientific management and control. As we have said, these are closely associated, for apart from large undertakings, with regular output, there can be no large laboratories, with highly trained and reasonably remunerated scientific staffs. On the other hand, apart from scientific direction the success of large combinations, such as Krupp's, would be impossible. The tendency of the war appears to have been in the direction of unifying and standardising many of our metallurgical industries, and this tendency is likely to continue when peace is proclaimed.

At present, owing to the war, there is a considerable demand for metallurgists in this country, and more particularly for such as have had a few years' works experience in addition to college training. Hitherto, the supply of such men has roughly met the demand, but the number trained has been wholly inadequate to the real needs of the country. The crux of the question is the want of recognition on the part of manufacturers of the value of scientific knowledge in their businesses. Three results may be expected from the work of a properly trained metallurgist, namely, greater uniformity, economy, and originality. But the system adopted in many British establishments, and particularly in those of moderate size, will never yield satisfactory results. A young man straight from college is appointed at a salary of perhaps 120*l.* per annum, placed in a small, ill-ventilated room, supplied with the minimum of apparatus, and kept on routine analyses. No prospect is held out to him of regular advancement, or of profit sharing. He sees office boys, who have had nothing spent on their education, promoted to be secretaries and general managers, because they come into personal contact with the directors; while he remains unseen and unknown to the powers that be.

Some public-school boys and university trained men are, from weakness of character, unfit for positions of responsibility. But the great majority of them are of a different type, and form the very best of our young manhood, as we see in other directions alike in peace and war. The position of the scientifically trained man in our metal works is very unsatisfactory. He has no trade union to protect his interests, and no professional body which is strong enough to fix a reasonable scale of remuneration. If our metallurgical industries are to be carried on successfully after the war many more properly trained metallurgists will be required. Capable men will only be attracted if suitable inducements are offered; otherwise they will naturally drift into other employments. In the midland counties, for example, the bright son of a local resident can be trained, at the expense of the State, to become an elementary schoolmaster; he will work twenty-five hours per week, and receive a pension. Or he may decide to study metallurgy, in which case he must spend at least 300*l.* on fees and maintenance, and devote three years to study. He will then get no higher stipend than the schoolmaster, no pension, and be expected to work about fifty hours weekly.

In Germany the value of scientific training has been long recognised. If we are to retain our position after the war it will be by development of industrial undertakings which are conducted on a large and comprehensive scale. Such employers alone can, as a general rule, utilise the best scientific training, or adequately remunerate and recognise their properly trained assistants. A man who has been trained on broad scientific lines is not merely capable of conducting, or superintending, accurate analyses. If he is treated as a confidential adviser, like a doctor or a lawyer, his abilities will have free scope. It is by such men that we can hope rightly to direct the large metallurgical operations which will be more than ever necessary in this country after the war.

T. T.

A MARKET-GARDEN RESEARCH STATION.[1]

FEW people other than those connected with the trade know of the extent and importance of the market-growing industry in this country. The general public is so accustomed to imposing statistics of imported fruit and vegetables that it is apt to ignore the not unsatisfactory fact that a large proportion of the market produce consumed in this country is home-grown. Still less does the public realise the extent of the capital and the skill and enterprise of the growers engaged in this industry. Although it may be regarded as lying beyond the scope of this severely practical first report of the work of the research station recently established by the growers in the Lea valley, we could wish, nevertheless, that the director had prefaced his account of the year's work by a short statement of the "statistics of production" in the market-growing industry. For we believe that such a statement would evoke widespread interest among the intelligent public.

Those who know of the origin and purpose of this new research station believe that it is destined to do a great work, and are anxious that its activities may not be curtailed by reason of insufficient

[1] First Annual Report (1915) of the Experimental and Research Station. (Nursery and Market Garden Industries' Development Society, Ltd.).

funds. The more widely its aims are known the greater the chances of this station receiving the support which it deserves. For deserve it, it does. When hard-headed, hard-working, practical men band themselves together and put their energies and money into the establishment of a research station, and particularly when these men are Englishmen, they deserve no less support than is given to a polar expedition or a football cup-final. Fortunately, this enterprise, due in the first place to the initiative of the Lea Valley and District Nurserymen's and Growers' Association, and also, as we believe, to the persuasive enthusiasm of Dr. Russell, of Rothamsted, has received a generous measure of support from the Board of Agriculture, from the Hertfordshire and the Essex County Councils, and from the Duke of Bedford. With the funds thus obtained laboratories and experimental glasshouses have been built at an outlay of 3278*l.*, of which sum all but 650*l.* has been paid.

A brief account of the preliminary researches carried out during 1915 will serve to indicate what a number of problems of practical importance emerge so soon as the searchlight of investigation is turned on an industry. As a preliminary to the investigation of yields of tomatoes, the soil of the five houses built for the cultivation of this crop was standardised. The soil in each house received the same amounts of lime, straw-manure, and bone-meal, and also similar treatment with respect to mulching, top-dressing, watering, etc. Fifteen varieties of tomato were grown in each of the five houses. Yet in spite of the similarity of soil conditions and of plants, the yields from the houses varied very considerably. House No. 2 stood highest with 3 tons 19 cwt. of fruit, and house No. 5 lowest with 3 tons 6 cwt.; in each case from 918 plants. Is this difference, which amounts to about 16 per cent., to be accounted for on the basis of experimental error, or is it to be attributed to some varying factor, such as the seed? In other words, would the isolation of pure lines of tomatoes help to bring the lower nearer to the higher yield? We have no doubt but that it would; but evidently the last word must lie with experiment.

Tests with humogen carried out with tomatoes and cucumbers offer no ground for the hope that this material is destined to replace manure or reduce cost of production. As with the experiments at Wisley and elsewhere, so here; the addition of humogen led to little or no increase in the crop, and the present writer is steadily inclining to the opinion that the remarkable results obtained at Kew were due to the accidental admixture of some fertiliser—presumably a phosphate—with the humogen which produced those results.

Very interesting are the results recorded in the report of observations on the yield of cucumbers from the slightly warmer and slightly cooler halves of four houses. In each case the part of the house nearer the boiler, and hence appreciably warmer, gave a lower yield. Anyone who has experienced the tropical warmth of a cucumber house must have felt that it was too much of a good thing. It looks as though the plants feel this too, and that a little rest from intensive speeding up of production is no less beneficial to them than to other living things. The director, Mr. A. B. Lister, is to be congratulated on the excellent start that he has made. He has a fine opportunity, and we feel sure that he will use it to the best advantage of the society which has had the enterprise and faith to harness science to the market cart. They will remember, however, that she is slow-moving, not showy, expensive to keep, and, above all, needs to be given her head. F. K.

NOTES.

IT is announced that the Government has decided to send an expedition to the Antarctic to relieve Sir Ernest Shackleton. The failure of the *Endurance* to put in an appearance gives cause for considerable anxiety; and while it is not impossible that she may still return unaided, no time can be wasted in organising relief. The arrangements for the expedition are to be put in the care of a small committee of polar experts, which is now being formed. Among those who will probably be asked to give their advice are Dr. W. S. Bruce, who is almost the only explorer in this country who knows the Weddell Sea, and Sir Douglas Mawson. Capt. J. K. Davis, who was recently in London on a short visit, has already been consulted. The choice of a ship will be difficult, as there are very few vessels in existence which are suitable for navigation in the Weddell Sea. In all probability the *Aurora*, despite the damage she has sustained, can be refitted and sent to the Ross Sea to fetch Capt. Macintosh and his comrades, who were left ashore in Erebus Gulf. Mr. Stenhouse, who brought the *Aurora* to New Zealand, is now on his way to this country.

A BRONZE memorial tablet to the memory of Capt. Scott and his companions, who perished on their return journey from the South Pole, has been placed in St. Paul's Cathedral. The memorial takes the form of a medallion portrait of Capt. Scott and a relief panel of the polar party on the march. It is surmounted by three allegorical figures—Discipline, Glory, and Courage. The tablet is the work of Mr. S. N. Babb, and is part of the national memorial scheme to the lost explorers, for which funds were collected when the news of the disaster became known. The inscription reads:—"In memory of Captain Robert Falcon Scott, C.V.O., R.N., Dr. Edward Adrian Wilson, Captain Lawrence Edward Grace Oates, Lieut. Henry Robertson Bowers, and Petty Officer Edgar Evans, who died on their return journey from the South Pole in February and March, 1912. Inflexible of purpose—steadfast in courage—resolute in endurance in the face of unparalleled misfortune—their bodies are lost in the Antarctic Ice—but the memory of their deeds is an everlasting monument." Mr. Asquith, in unveiling the memorial last Friday, said that whatever softening influences may have been at work during our long years of peace, there were never wanting men of our race to maintain our best traditions of courage and endurance. The heroism of the lonely end of Scott and his companions might, in these crowded days of great opportunity, be equalled, but could not be surpassed. These were men who, before the great ordeal which, on a world-wide stage, is now testing our national manhood, showed in the dim polar twilight, without witnesses, and, for all they knew, with no record which would ever reach their countrymen, the supreme quality of self-forgetful courage and endurance.

THE *Nieuwe Courant* learns from Frankfort that Prof. August von Wassermann, at present head of the Royal Institute for Infectious Diseases at Berlin, will be appointed director of the Institute for Experimental Therapy and of the Georg Speyerhaus at Frankfort, in succession to the late Prof. Paul Ehrlich.

SIR R. HAVELOCK CHARLES, Serjeant-Surgeon to the King, and President of the Medical Board of the India Office and of the Society of Tropical Medicine and Hygiene, has, at the request of the Secretary of State for India, accepted an invitation to become dean of the London School of Tropical Medicine in succession to the late Sir Francis Lovell.

ANNOUNCEMENT was made in the House of Commons on May 8 that the following had been appointed a Committee to inquire into the administration of the Royal Flying Corps:—Mr. Justice Bailhache (chairman), Mr. J. G. Butcher, M.P., Mr. E. Shortt, M.P., Mr. J. H. Balfour Browne, K.C., the Hon. Sir C. Parsons, K.C.B., and Mr. Charles Bright. A military officer of high rank is to be invited to join the Committee.

ON account of the war, the council of the British Medical Association has decided to postpone as regards 1916 the holding of an annual meeting at Cambridge. In the present circumstances the council has arranged that the annual representative meeting and statutory general meeting shall be held at the Connaught Rooms, London, on Friday, July 28. In the annual report, to be presented at that meeting, the council recommends that Sir T. Clifford Allbutt be elected president of the association for 1916–17.

UNDER the auspices of a commission appointed by the Imperial Academy of Sciences of Petrograd, a series of monographs is being published dealing with the natural resources of the Russian Empire. No. 5 of the series (Petrograd, 1916) treats of the native sources of tungsten and tin ores. The author, P. P. Suščinskij, says that hitherto neither the mining nor the smelting of these ores has been organised on a regular basis in Russia, but that quite recently, in response to the requirements of Russian industry and of the Imperial Defence Committee, an electro-metallurgical company has been formed in Petrograd for the preparation of special kinds of steel for the Admiralty. The article concludes with an illustrated account of Russian tungsten and tin mines.

THE annual meeting of the British Science Guild will be held at the Royal Society of Medicine, 1 Wimpole Street, London, W., on Wednesday, May 17, at 4.0 p.m. The chair will be taken by the president, the Right Hon. Sir William Mather, P.C., and an address will be given by the Right Hon. Andrew Fisher, P.C., High Commissioner for the Commonwealth of Australia, on "The Establishment of a National Institute of Science and Industry in Australia." Other speakers will be Sir Alfred Keogh, K.C.B., Dr. R. Mullineux Walmsley, Sir John S. Young, and Prof. J. Perry, F.R.S. On account of the public attention recently given to the relation of science to national affairs, the meeting this year will be of exceptional interest. Tickets of admission may be obtained from the secretary, British Science Guild, 199 Piccadilly, London, W.

MR. CORNELIUS HANBURY, who died on April 11, in his eighty-ninth year, was the chairman of the board of directors of the well-known firm of Allen and Hanburys, Ltd. Although Mr. Hanbury had trained and qualified for the medical profession he entered the business very early in his career, and eventually became the sole proprietor. Under his able guidance rapid development took place, laboratories and other premises being established at Bethnal Green, and, after the conversion of the business into a company, at Ware also. He was cousin of the late Daniel Hanbury, whose work in connection with the natural history of drugs is recognised as classical, and also of the late Sir Thomas Hanbury, whose magnificent gardens at La Mortola, near Mentone, were the admiration of every scientific botanist. Mr. Hanbury served for some years on the council of the Pharmaceutical Society of Great Britain, acting as treasurer from 1876 to 1878.

PROF. H. P. WIJSMAN, whose death at Utrecht on March 19 is announced, was the son of an Amsterdam pharmacist, and studied at the Amsterdam University under Profs. van't Hoff, de Vries, and Oudemans, taking the degree of Doctor of Science in 1889. Very shortly after graduating he was appointed chemist to a yeast and spirit factory at Delft, but soon resigned this position to become professor of toxicology at Leyden University. To great versatility Prof. Wijsman added, in an unusual degree, the desire and ability to organise. He was instrumental in founding a pharmaceutical laboratory in Leyden, and in establishing an analytical bureau and an Imperial control station for milk, butter, and cheese. On his return from the Dutch East Indies, he took an active interest in the development of the celebrated Colonial Museum of Haarlem and its transference to the more central position of Amsterdam. He represented the Dutch Government at numerous scientific congresses, and attracted considerable attention at the recent International Pharmaceutical Congress at The Hague by a lecture on the cultivation of important plants in Java, which was illustrated by a series of kinematograph films. Prof. Wijsman's ability and geniality gained him many friends, and his loss will be felt by his British as well as by his Dutch colleagues.

THE death of Mr. C. Lees Curties, which occurred on April 24, will be greatly lamented by a large circle of scientific men, many of whom will feel that they have lost a personal friend, as well as a notable figure in the optical world. He and his father before him had built up a unique business, and 244 High Holborn was regarded by many as a rendezvous where one was sure to meet some kindred spirit and to hear the latest scientific news. Mr. C. L. Curties greatly extended the business by the establishment of a factory where microscope stands are made, and of an optical department for the construction of object glasses. He had a thorough knowledge of the microscope (of which he was a most expert manipulator), as well as a wide and varied acquaintance with all sorts of scientific instruments, owing to the great number that was constantly passing through his hands. He was always ready to place his expert knowledge at the disposal of anyone who asked his advice. There can be little doubt that his death was hastened by the heavy strain due to extra work on account of the war, and to his persistent refusal to give himself a much-needed holiday.

WE have just learned with regret that Prof. Jules Gosselet died at Lille on March 20, as the result of a chill contracted while arranging his geological collection in the University after recent disturbance by the bombardment of the city. Prof. Gosselet was born at Cambrai (Nord) on April 19, 1832, and began his well-known geological researches in the Franco-Belgian coalfield and surrounding regions in 1852. From 1865 until 1902 he was professor of geology and mineralogy in the University of Lille, and numbered among his pupils many distinguished French geo-

logists, including his successor, Prof. Charles Barrois. From 1876 onwards he co-operated with the Geological Survey of France, and in 1888 published his classic memoir on the geology of the Ardennes. His work on the Devonian and Carboniferous rocks especially was not only of fundamental scientific value, but also touched many problems of economic geology which were of immediate importance to the community in which he lived. He was an inspiring teacher and an ideal leader of field excursions, and retained his active enthusiasm until the end. On his retirement in 1902 his friends and admirers established a Gosselet prize for geology, and placed a bust in the museum he founded at Lille, and the account of the proceedings in the *Annales de la Société Géologique du Nord* (vol. xxxi.) is accompanied by an excellent portrait of the professor. He was a foreign member of the Geological Society of London, and was awarded its Murchison medal in 1882.

THE memorandum advocating the substitution of nitre-cake for sulphuric acid in the manufacture of sulphate of ammonia, recently issued by the Ministry of Munitions, having been severely criticised, the proposal has been examined by the Sulphate of Ammonia Association. The latter body recommends makers of sulphate of ammonia to use nitre-cake as a temporary expedient for the duration of the war, subject to the following considerations:—(1) That no attempt be made to produce a salt containing less than 24 per cent. of ammonia unless special forward contracts can be made with manure mixers for lower qualities; (2) that the nitre-cake used should not contain more than 0·05 per cent. of nitric acid; (3) that the quantity of nitre-cake should not exceed 10 per cent. by weight of the acid used, except in special circumstances. If a larger quantity than 10 per cent. of nitre-cake is employed difficulties arise from two causes: first, from precipitation of sodium sulphate, resulting in the production of an irregular quality of salt; secondly, from irregular working of the bath owing to the impossibility of control without frequent titration.

SOME French anthropologists have taken the trouble to examine on scientific principles the character of the remarkable wooden Hindenburg figure which the enthusiastic German loyalists have been invited to decorate with nails of gold and other metals. In *L'Anthropologie* (vol. xxvii., Nos. 1–2, for January-April) M. R. Verneau compares them with a collection of remarkable fetishes decorated in the same way by the negroes of equatorial Africa and the adjoining regions, of which he gives a number of excellent illustrations, both animal and human. He expresses the pious assurance that the German devices will be as useless as the savage fetishes from Loando, and that it is not by the use of such methods current in the lower culture that the ultimate triumph of civilisation can be prevented.

IN the Journal of the Royal Society of Antiquaries of Ireland for December, 1915, Mr. J. J. Buckley contributes an interesting article on some early ornamented leather work. Ireland possesses many specimens of this class of work, such as the satchel which holds the famous MS., the Book of Armagh, in the library of Trinity College; that associated with the shrine called the Breac Moedóig in the National Museum; and a binding of the Life of St. Columba in the Franciscan Library, Dublin. Other satchels of the same type are preserved at Stonyhurst College and at Corpus Christi College, Oxford. There is good evidence that the Irish in very ancient times were acquainted with the use of oak bark for tanning leather, but whether this process was used in the manufacture of the material of these satchels is uncertain. The date of these specimens still remains a matter of speculation. That of the Book of Armagh was obviously not made to protect the MS., and the same appears to be the case with the specimen in the National Museum. But that at Corpus Christi College seems to have been made for the book which it covers. The satchel at Stonyhurst has been attributed to the seventh century, but Count Plunkett places it as late as the beginning of the seventeenth. In any case, the style of ornamentation is early, and it may be hoped that as we now possess in this paper excellent photographs, a further study will decide the date of a class of work which is of interest for the study of Irish art.

IN NATURE of December 30, 1915 (vol. xcvi., p. 487), appreciative reference was made to part ii. of the third volume of the monograph by Howard, Dyar, and Knab on the mosquitoes of North and Central America and the West Indies. It was remarked in the note that vol. ii., containing the illustrative plates, "has presumably not yet been published, as we are unable to trace its receipt." Dr. L. O. Howard writes to remind us that vol. ii. was issued at the same time as vol. i. (1912), and this fact is mentioned in a long review published in NATURE of June 26, 1913 (vol. xci., p. 420).

IN the *Zoologist* for April Capt. Philip Gosse contributes a brief but very welcome account of the mammals which he obtained in Flanders during such leisure moments as his duties with a field ambulance allowed him. The list is not a long one, but it contains some interesting items, among which figure some noteworthy colour variations of the water shrew (*Neomys foidens*). The black rat he found to be pretty common in the farm buildings, where it was living in company with the brown rat, a somewhat unusual occurrence. In the trenches, however, it does not seem to have been met with, but the brown rat swarms there.

ORNITHOLOGISTS owe much to Mr. Edmund Selous for the strenuous efforts he has made to secure protection, during the breeding season, for birds breeding in Iceland, the eggs of which are coveted by the egg-collector. In some cases he has only been able to achieve this end by fully compensating the local collectors for the loss of revenue they sustained by leaving the sitting birds unmolested. These efforts he describes incidentally in the *Zoologist* for April, in the course of his account of his ornithological observations made in Iceland during 1912. His efforts to keep a continuous watch on a pair of nesting eagles were frustrated by the intolerable attacks of swarms of mosquitoes, which here gathered in clouds so dense as to obscure the sun.

THE annual report of the Zoological Society of London never fails to furnish items of interest. Having regard to the anxious times through which we are passing, the report for 1915, just issued, assumes an enhanced importance, since it affords us an index both of our financial stability and our capacity for study and recreation. Though partly by deaths and partly by resignations the number of fellows of the society has been reduced by nearly a hundred, the number of visitors has been well sustained, so that the society, at the end of the financial year, finds itself in possession of ample funds. The cost of provisions has increased materially, and the council has therefore considered it prudent to decrease the stock by disposing of some animals that could easily be replaced. Apart from the cost, there has been no difficulty in obtaining the necessary supplies of food for all the animals in the Gardens, and although

special endeavours have been made to replace expensive articles of diet by less costly substitutes, the normal food has been at once supplied in those cases where the health of the animals appeared to suffer.

EXPERIMENTS on the action of tobacco decoctions in destroying certain insect pests of the vine are described by Dr. Mario Topi in the *Atti dei Lincei*, xxv., (1), 5. Two varieties of grape vine were selected, and it was found that with two applications of the decoction the larvæ of Eudemis were about half as numerous on the treated plants as on the others, and those of Conchylis were slightly lower too. On the other hand, the number of damaged branches was also reduced by about 50 per cent. by the treatment.

THE heavy loss of nitrate by washing out from arable soil during the wet winter of 1915–16 is very clearly shown by Dr. E. J. Russell and Mr. A. Appleyard in the current number of the *Journal of the Board of Agriculture*. The most striking case is that of the Broadbalk dunged plots at Rothamsted, one of which was fallowed and the other cropped. During the summer the fallow plot accumulated nitrate until, by the middle of September, the top 18 in. of soil contained 170 lb. of nitric nitrogen per acre, equivalent to nearly 10 cwt. of nitrate of soda. The losses then began, and were so heavy in November and December that by February the magnificent stock of nitrate had been reduced to 50 lb. of nitrogen. This loss is equivalent to 7 cwt. of nitrate of soda, no small item at present prices. The Broadbalk fallow plot is no doubt an extreme case, but the cropped plot also suffered considerable loss. It never accumulated nitrate like the fallow plot, the maximum being 90 lb. of nitrogen per acre; half of this was lost during the winter, or as much nitrogen as is contained in 24 bushels of wheat and the corresponding amount of straw. The losses are naturally greatest on these heavily manured soils, but the fields which were not unusually well done lost about 30 lb. of nitrogen per acre. Some of the loss on the fallow plot could have been prevented by sowing mustard or other quick-growing crop in September. This could have been fed off or ploughed in, thus holding the nitrogen in less soluble form until the spring. The obvious lesson is that land which has been got into good condition in autumn should at once be sown with either the crop it is intended to carry or a catch crop.

THE Summary Report of the Mines Branch of the Department of Mines for 1914 has just been issued by the Canadian Government. This gives a brief *résumé* of the work done by this branch during the year in question, together with a preliminary report on the mineral production of the Dominion. It appears that there is a falling off in the output of nearly all mineral products and metals, the only exceptions of any importance being in the two items of pyrites and natural gas; in the former the increase amounts to 42 per cent., in the latter to only 3 per cent. The total value of the mineral production is given as 128,475,499 dollars, as against 145,634,812 dollars in 1913. The decrease is stated to be due to conditions arising from the war, owing to which many mines have either closed down or decreased their activities. It is not to be inferred that the diminution is due to any other than temporary causes.

THE Geological Survey of Great Britain has issued a memoir (price 4*s*. 6*d*.) on "The Thicknesses of Strata in the Counties of England and Wales, exclusive of Rocks Older than the Permian." The director, Dr. Strahan, has taken a large share in the preparation of this useful work of reference, which will aid teachers in drawing up correct geological sections, and will serve as a permanent guide to those who seek for water or for coal. Sketch-maps are given of each county, showing the sites where subterranean information has been obtained, and in some cases contour-lines are drawn to mark the depths below sea-level at which certain important horizons may be struck. The base of the Permian (or top of the Coal Measures) is thus included in the features shown in Nottinghamshire. The lowering of the denuded chalk surface below sea-level and the infilling of its hollows by Glacial deposits are well seen in the map of Norfolk, where the Saham Toney boring passed through 248 ft. of Glacial drift, the base of which lies more than 100 ft. below the sea. Under the head of Kent, we note that the Dover boring has penetrated 1152 ft. of Coal Measures. The depths at which coal-bearing strata have been reached in other counties, such as Cheshire and Leicestershire, will be looked on with interest by economists.

THE United States Coast and Geodetic Survey has issued a tabulated list of the geographical positions on the North American Datum, with descriptions and elevations of all triangulation stations on the coast and geodetic survey in Alabama, on the Gulf Coast in Mississippi, and on the eastern oblique arc in Louisiana (Special Publication, No. 24). The field work of the triangulation included in this publication was done between the years 1846 and 1911, and many of the original stations could not be recovered, but where possible stations were remarked. The results of the entire eastern oblique arc triangulation appeared in a previous publication in 1901 (Special Publication, No. 7). That publication, however, dealt primarily with the purely scientific problem of the determination of the figure of the earth, and only the positions of those points included in the main scheme of triangulation were published.

PROF. HILDERBRANDSSON (*Kungl. Svenska Vetenskapsakademines Handlingar*, Band 51, No. 8) gives some further results of his researches. He states that in winter the course of the meteorological elements over the part of the ocean lying between Iceland and Norway agrees with that which occurs over the north of Europe, but is in opposition to the course of the same elements over the subtropical region, the Azores to the Mediterranean. The same opposition between north and south is said to occur in North America, but inversely to the relation in Europe, so that if the winter is cold in the north of Europe, it is cold in Mexico and the United States, but mild in the south of Europe and in the north of North America. Various other relationships are given, and are supported by tables and charts. If the correlation coefficients were worked out they would not be very high, but Prof. Hilderbrandsson states that the relations are disturbed by external causes of a superior order, such as the varying heat of the sun.

SOME observations on the green ray sometimes observed at sunrise and sunset are described by G. Guglielmo in the *Atti dei Lincei*, xxv., (1), 5. The author discusses the various theories that have been advanced to account for the fact that the duration of the phenomenon may exceed the limit attributable to dispersion. He finds, moreover, that the ray is sometimes more bluish and sometimes less so. Among the various causes which may modify the effect or its duration are mentioned atmospheric absorption of the violet and indigo rays, waves in the atmosphere, and abnormal variations of density in the lower strata.

Of course, if the sun sets behind a sloping hillside, the duration may be considerably altered by this cause.

THE March number of *Terrestrial Magnetism and Atmospheric Electricity* contains a table by Mr. J. P. Ault of the values of the deviation of the compass from true north in the Bering Sea and the Pacific Ocean, determined by the magnetic survey ship *Carnegie* during her voyage from Alaska to New Zealand in the latter half of 1915. Throughout the whole of her course, which from the western side of the Bering Sea was almost directly south, the compass pointed to the east of true north by amounts varying from half a degree in latitude 45° N. to 16° or 17° at Alaska and New Zealand. The British Admiralty charts give the compass deviation too high by amounts which, in the Bering Sea, exceed a degree, and in latitudes 37°, 21°, 14°, 12°, 0° N., 15° and 45° S. are nearly a degree.

BULLETIN 609 of the United States Geological Survey deals with the fractional precipitation of some ore-forming compounds at temperatures only slightly removed from atmospheric, and in all cases below 100° C., by Mr. R. C. Wells. The experiments have been made with the object of elucidating the chemistry of ore deposition, and they have shown the order of solubility of the compounds of each of the classes investigated—sulphides, hydroxides, carbonates, and silicates. On the whole, the most interesting, and probably the most complicated, series is that of the sulphides. Soluble sulphides may act, and do act, not only as precipitating, but also as reducing agents. It appears from the results given that the concentration of the sulphide ion is so greatly affected by change of acidity that the latter is the principal factor determining the precipitation of sulphides. A mixture of two metallic salts yields, by fractional precipitation, an initial precipitate, containing the sulphides of both metals, but, as a rule, if the mixture is heated or is permitted to stand, one sulphide largely or wholly dissolves. The order of precipitation, beginning with the metal that separates first, is palladium, mercury, silver, copper, bismuth, cadmium, antimony, lead, zinc, nickel, cobalt, ferrous iron, arsenic, thallium, and manganese. Attempts to form chalcopyrite by fractional precipitation of ferrous and cupric sulphate were unsuccessful.

PAPER No. 33 of the Survey Department of Egypt, entitled "The Magnetic Survey of Egypt and the Sudan," by Mr. H. E. Hurst, embodies the results of field observations made by the author and Mr. C. B. Middleton between October, 1908, and January, 1914. Use is also made of observations taken between 1893 and 1901 by Captain (now Major) H. G. Lyons, F.R.S., and of the results obtained in the Red Sea between 1895 and 1898 by Lieut. Rössler, of the Austrian surveying ship *Pola*. The publication includes charts of magnetic declination, inclination, and horizontal force respectively. The epoch to which the observations are reduced is January 1, 1910. Helwan, where magnetographs were installed in 1907, served as base station. The area dealt with extends from Damietta, 31° 25′ N., to Wadelai, 2° 42′ N. lat.; but it is comparatively narrow, especially in the extreme south. A remarkable feature is the closeness with which the lines of equal dip—from 42° N. to 16° S.—conform to parallels of latitude. The magnetic equator crosses the Nile at about 11° N. lat. The lines of equal declination have mostly throughout the greater part of their length the same general direction as the Nile. The lines of equal horizontal force, from 0·295 to 0·350 C.G.S., seem to cross the Red Sea nearly orthogonally. The local disturbances encountered were extremely small, especially in comparison with those described by Prof. J. C. Beattie in his "Magnetic Survey of South Africa."

A COPY of the report of the secretary of the Smithsonian Institution for the year ending June 30, 1915, has been received. The report reviews the affairs of the institution, and summarises the activities of its several branches. Among the explorations and researches inaugurated in furtherance of one of the fundamental objects of the institution, which is the "increase of knowledge," we notice the clearing of fog by electrical precipitation. The fact was long ago established that all dust and fog particles in the open atmosphere are electrified and subject to dispersion or precipitation, but how to clear fog from a street, along a railway, or from the neighbourhood of a ship at sea, and to do it in a manner commercially feasible, has been a matter of study for many years. The question recently aroused fresh attention in the neighbourhood of San Francisco, through researches planned by the University of California in co-operation with the United States Lighthouse Service, and it was decided by the Smithsonian Institution to make a grant to further this investigation, which is under the general direction of Dr. F. G. Cottrell. The American Institute of Electrical Engineers has also appointed a committee to co-operate in this work. The essential element to success in scattering fog seems to be some form of electrical apparatus of very high direct voltage, with facilities for its control and ready application.

THE H. W. Wilson Company, White Plains, New York, has published a supplement to the "Readers' Guide to Periodical Literature," which forms an index to general periodicals not included in the guide. The periodicals indexed in the supplement include NATURE, the *Hibbert Journal*, the *Philosophical Review*, and others published in this country.

OUR ASTRONOMICAL COLUMN.

URANUS.—This planet is now an early morning object in the constellation of Capricornus. When its position is known it is easily visible with quite small apertures; thus on April 29 it was seen with a hand telescope of $1\frac{1}{3}$ in. opening, at G.M.T. 3h. 34m. The dawn had then, of course, overpowered all stars in the region. On May 12 the position of Uranus will be R.A. 21h. 13·2m., declination −16° 47·6′, diameter 3·8″.

MERCURY.—On September 21 of last year Mercury passed within 1′ of Spica, and a long series of positional measures was secured at the Union Observatory, Johannesburg (Circular No. 30). The observations made by Messrs. Innes and Worssell with a 9-in. refractor possess exceptional interest, as both observers agree regarding the visibility of a small N. polar cap and an indistinct band south of it. This appears on the reproductions as a narrow dusky zone in about latitude 45°. As an index to the conditions under which the observations were made, it may be stated that the conjunction occurred six days prior to elongation, the diameter of the slightly gibbous disc being 6·2″. The data indicate that the approximate G.M.T. of conjunction was 2h. 57m. 42s., when the zenith distance of Spica would be 51° 4′ at the Union Observatory. The truncated cusp recorded by other observers may perhaps find an explanation in this Johannesburg observation.

THE LYRID METEORS OF 1916.—Mr. W. F. Denning, writing from 44 Egerton Road, Bristol, says:—Cloudy weather seriously interfered with the observa-

tions. On April 20 Mrs. Wilson, at Totteridge, recorded several meteors between 9.30 and 10.45, when it became overcast. A bright meteor was seen at 9.46 p.m., with radiant at $202°+8°$. Two bright Lyrids were seen at Bristol at a later hour. On April 21 Miss Cook, at Stowmarket, saw about twelve meteors, including eight Lyrids, between 9.39 and 11.49 p.m. On April 23, 25, 26, 29, and 30 Mrs. Wilson obtained further observations, and meteors were also seen at Bristol on the same nights, but they were very scarce, notwithstanding the splendid skies presented on several of the dates mentioned.

The most important observation was that of a bright but very late Lyrid on April 26, at 9.49, by Mrs. Wilson and by the writer at Bristol. The two observations proved that the centre of the shower was at $278°+35°$ on that night, and that the radiant is really a moving one, the position being at $271°+33°$ on April 20.

Below are the observed paths of a few brilliant meteors, duplicate observations of which would be very valuable.

Date	h.	m.	Mag.	From °	°	To °	°	Observer
April 20	9	46	1	234	+10¾	243	+10	Mrs. Wilson
	11	1	1	256½	36	226	35	W. F. D.
	11	6	1	276¼	14½	276½	13	W. F. D.
21	11	22	1	215	25	205	20	Miss Cook
	11	49	4 × ♀	202	25	190	18	Miss Cook
25	10	1	1	240½	29	237¼	20	Mrs. Wilson
	10	53	♀	323	52.	341	38	Mrs. Wilson
26	9	49	1	211	51	184	46	W. F. D.
29	9	32	♂	235	4½	244	2¼	Mrs. Wilson
	11	17	1	187	− 6	184	−13	Mrs. Wilson
30	11	17	1	278½	20	276	18	W. F. D.

SCIENCE IN EDUCATION AND THE CIVIL SERVICES.

THE meeting convened by the committee formed in connection with the memorandum on the "Neglect of Science," published in February last, held on May 4 at Burlington House, was remarkable for its enthusiasm, its size, its unanimity, and its representative character. Leading and lesser lights belonging to science, literature, art, and commerce came from all parts to affirm their faith that our educational system needed rectification in the interest of physical science, in order to minimise the frequency of the occurrence of national "regrettable incidents." The lecture theatre of the Linnean Society was densely packed, and for three hours the audience listened with close attention to the convincing periods of the twenty-five speakers supporting the resolutions submitted.

Lord Rayleigh, Chancellor of the University of Cambridge, presided, and in his opening remarks he referred to the deplorable ignorance of science shown by all classes of society. In indicating the remedy, Lord Rayleigh emphatically denied that men of science had any desire to abolish or to cripple the study of literature—a point that was endorsed by many later speakers. The modern curriculum was already congested, and place must be made by limiting the study of ancient languages. "There is a certain type of mind for which classical education is best, but for the majority of schoolboys I think it is nothing less than an absurdity to talk about impressing them with the language and literature of the ancients. Such a result is not achieved with the average boy. I was myself an average boy. A great friend and brother-in-law of mine, Henry Sidgwick, used to say that the greatest impediment to a literary education was classics."

In proposing the first resolution, "That the natural sciences should be made an integral part of the educational course in all the great schools of the country, and should form part of the entrance examination at all the universities," Sir E. Schäfer replied effectively to the contention that men of science need a classical education in order that they may be able to express themselves clearly, and the unprejudiced eye-witness of the meeting could not have failed to remark that devotion to science was in no way incompatible with the power of clear expression and a sense of literary perception. Dr. Bridges, the Poet Laureate, seconded the resolution in a forcible speech, in which he advocated a drastic reform of our educational system. A knowledge of the world we live in, and of our own bodies, is a vital necessity to all classes. The question of remunerating the teachers adequately was also of urgent importance.

The Rt. Hon. Huth Jackson, director of the Bank of England, deeply regretted his ignorance of science, the knowledge of which would have prevented him from supporting commercial ventures which in themselves were unsound, and in other cases would have made him abandon the banker's typical attitude of refusing to listen to any new idea. Lord Montagu of Beaulieu dealt principally with the neglect of science in Government circles. Six years ago he had warned the Government that it should take in hand the manufacture of acetone, which is indispensable for the production of propellant powder. The advice was unheeded, and at the beginning of the war this country possessed but a single toy plant in the Forest of Dean. He had also pointed out the importance of low-temperature distillation of coal, from which benzol, toluol, and other by-products are obtained, including T.N.T., essential for our Army; but nothing was done. In the year before the war we spent 500,000*l.* with great reluctance on aviation experiments; Germany spent seven millions. "Where America has more than 250 people at work in a certain research department, in this country we have only four or five. The attitude of the nation towards science is not one of dislike, but of contemptuous neglect. There is an infinite field for the use of science in the Government of the country. In India there is no scientific adviser to the Government. The country is pre-eminent to-day in pure science, but not in applied science, or as regards general scientific education all over the country."

Dr. Macan, master of University College, Oxford, said that by making the study of English and of science two of the corner-stones of our educational edifice, we should be working in the truest spirit of Hellenism. The genuine study of antiquity would not suffer by limiting the amount taught in our schools, and the idea that the curtailment of such instruction would demoralise our youth was a delusion; for ethical and physical training are the chief factors in the formation of character. The science students at Oxford had sacrificed themselves in the war no less than their literary comrades. Mr. H. G. Wells urged the importance of distinguishing between the kind of teaching required for the training of science specialists and that which should be part of the education of all. The latter kind would involve a much smaller expenditure upon apparatus than the former, and would not demand more than 10–15 hours per week. "We want the elementary Greek which is done in schools, and which does not go on to a thorough knowledge of Greek, to be cut out. We want to stop Latin verse-making for most pupils; and we do not believe in the premature teaching of history to a child whose political sense is entirely undeveloped. We do not propose to make the philosopher supreme in this country at present, but we do want to bring our statesmen into a relationship of co-operation with

the mass of scientific and practical knowledge which has accumulated in the course of civilisation." Our lawyers and politicians had failed lamentably from want of scientific and practical knowledge, but they could not be exterminated; they must be "practical-ised," brought to see the virtue and necessity of natural knowledge, and to know how to apply it.

The second resolution affirmed the necessity of assigning capital importance to science in the examinations of the higher branches of the Civil Service, and of making it an obligatory subject for entrance to Sandhurst. The proposer, Sir Harry Johnston, subjected the present regulations to a scathing criticism, and emphasised the unpractical nature of the examination questions, which were not framed with the object of testing the knowledge and ability of candidates in matters which they would need in their careers. Introducing the third resolution, Sir Ray Lankester declared that for seventy years the cry of the reformer had been heard, but with no practical result. The governing classes and the Press were united in supporting the existing conditions, and the only practicable proposal for immediate action was to alter the basis of Civil Service examinations. The great schools could not move because they were dominated by the universities, and the latter were shackled by the Civil Service regulations; apply the pruning-knife to the last-named, and the body educational would immediately acquire the power of regeneration.

Other notable speakers were Lord Portsmouth, Profs. Thomson, Poulton, and Dr. Parnell, of Oxford, Dr. Shipley, of Cambridge, the headmaster of Sherborne School, Colonel Crompton, Sir Hugh Bell, and Mr. A. Dyke-Acland. The fourth resolution, authorising the committee to bring the proposals to the notice of the Government, was, like the others, passed unanimously; and the uppermost thought in our minds as we left this memorable gathering was the hope that "the eyes of men might be opened that they may see light."

NATIONAL FOOD SUPPLY AND NUTRITIONAL VALUE.[1]

THE statistics of our national food supply, in so far as they have been available, have hitherto comprised no more than bald statements as to the amount available of this or that marketable foodstuff. We have been told how much meat, home-killed or imported, has been upon the market, how much wheat, potatoes, etc., but no one has as yet taken the trouble to determine the actual nutritional value of the food supply we have to rely upon. Without such knowledge it is impossible properly to appraise the national position, or determine whether we have a safe margin upon which to draw when retrenchment is called for. The truth, as Prof. W. H. Thompson points out in the very timely study before us, is that we are in such matters a happy-go-lucky people, and leave the nation's affairs too implicitly in the hands of our legislators and administrators without insisting that business or scientific knowledge shall be sufficiently taken into account. So far as it is possible to do so Prof. Thompson has now given us the information required, and the preparation of his paper must have cost him much labour. He tells us how much protein, how much fat and carbohydrate, and how many calories of food energy are available for the nutrition of Great Britain as a whole. His survey of the subject has been made independently, without reference to previous investigations.

Anyone endeavouring to collect data which will represent the position with accuracy meets with difficulties. Chief among these is that arising from the fact that in the food estimates for Great Britain no figures are given for agricultural produce fed to live stock, or consumed by the population of the farms. Prof. Thompson, in making a correction for this deficiency in the statistics, assumes that the agricultural population is at least as well supplied with the produce of the farms as is the general population. We doubt whether he is altogether right in this assumption, believing that the agricultural labourer gets on the whole less than his share of the foodstuffs he is instrumental in producing. Other difficulties have to be overcome in the endeavour to arrive at a final estimate, and we cannot at present expect complete accuracy. In the study under review it is clear that every effort has been made to obtain the best possible information.

Of the total protein supply of the nation, 33·75 per cent. is furnished by grain foods, of which 74 per cent. is imported, 10·56 per cent. by vegetables, 31·62 per cent. by flesh meat, of which more than half is imported, 15·06 per cent. by dairy products, and about 2·5 per cent. by eggs. The author points out that much more might be made of eggs as a source of protein supply, by increasing the home produce. Of the carbohydrate supply, 54·26 per cent. is drawn from cereal food, 24·5 per cent. from sugar, 14·55 per cent. from vegetables, the only other source of any consequence being dairy products (excluding butter), which add 3·32 per cent. Of the fat available, 47·04 per cent. is derived from meat, 30·18 per cent. from dairy products, 13·25 per cent. from lard and margarine, and 5·14 per cent. from cereal foods, the remaining sources being relatively unimportant.

Prof. Thompson's calculations lead to the conclusion that taking the nation as a whole only 10 per cent. of the total food energy is supplied in the form of protein, or, as the author puts it, "one-tenth of the driving power of the human engine is derived from protein material." No less than 59 per cent. of the energy is supplied as carbohydrate; fats yield 30 per cent.

It is customary when calculating the food available for individuals from statistics referring to the whole community to reduce the population to "man" value. This is done by reducing the figures for women, and those for children of different ages, by means of certain factors based upon the supposed relative nutritional demands. The figures representing the total food values available are then divided by the "reduced" population, and the result gives the amounts available "per man." So calculated, the quantity available for the daily ration of a man works out at 101·7 grs. protein, 587·12 grs. carbohydrate, and 136·5 grs. fat; corresponding to 4129 calories in energy value. Knowing what is actually available, we are now in a position to decide how far we can safely economise in our consumption, and having clear information as to the relation between imports and home-grown foodstuffs, we can measure what would be the effect of any serious interference with the former.

The above figures, based as they are upon statistics from ports and markets, may prove, however, a little puzzling to those accustomed to study the actual dietaries of English families. The value for protein seems low, and that for the total energy seems high. The figure, 101·7 grs. protein, represents a gross value for foods delivered at the ports or sold off the

[1] "The Food Value of Great Britain's Food Supply." By Prof. W. H. Thompson. Reprinted from the Economic Proceedings of the Royal Dublin Society, Dublin. (Dublin: Royal Dublin Society; London: Williams and Norgate.) Price 2s.

farms, and must be reduced to something like 97 grs. for the ration "as purchased." This, however, is about the amount consumed by the more poorly fed among the population—by the agricultural labourer, for instance. One would have expected the average for the whole country to be appreciably higher. On the other hand, the value 4129 calories (3875 "as purchased") seems high for the energy ration, and the proportion it bears to the figure for protein is exceptionally high. We cannot but think that Prof. Thompson has failed to make sufficient allowance for the starch, and especially for the fat, which, while appearing in the market returns, is diverted to industrial uses and never reaches the mouth of the consumer. If the figure for protein accurately represents the available supply and measures our consumption before the war it would seem that there is not much room for economy in the amount eaten.

Prof. Thompson, in considering the possibilities of economy, emphasises, however, a point upon which most writers have insisted: "The British nation as a whole relies too much on flesh meat for the protein element of its food. This is the most costly of all the common articles of diet to produce." He has himself shown, "from calculations based on average results, that an acre of land, if used for grazing sheep or cattle, produces per annum not more than 260 oz. of protein, and 290 kilolitre calories of energy. Whereas, if used for tillage, the same area of land produces in wheat 19 times as much protein, and 15 times as much food energy; in beans 20 times as much protein, and 9 times as much food energy; in peas 10 times as much protein, and 4 times as much food energy; in potatoes 17 times as much protein, and 30 times as much food energy."

"Economy practised in the direction indicated would entail no loss of efficiency, and would work out to the economic advantage of the country as a whole. It would also have another indirect result. The food of Great Britain is brought from the ends of the earth, the charges for transit adding considerably to its cost. A man of twelve stone weight requires, as already stated, nine times his own weight of food every year, or three-quarters of his own weight every month. This entails in freight charges an outlay which adds considerably to the food item in a working-class budget. Every additional ton weight of home-produced food should reduce this sum, if freight charges be justly apportioned."

THE FUTURE OF CHEMICAL INDUSTRY.

AT a recent meeting of the New York Section of the Society of Chemical Industry, Dr. Baekeland was awarded the Perkin medal for his discoveries in technical chemistry. Dr. Baekeland, in acknowledging the honour, gave an interesting account of the introduction of the well-known Velox paper into photography, and the successive steps in the production of bakelite—an artificial resin of great hardness and durability, which has found a variety of important applications.

The portion of the address which should command most attention at the present time is not so much the account of the inventive skill, tenacity of purpose, and never-failing resourcefulness, associated with a highly-trained scientific mind, which have brought Dr. Baekeland's investigations to a successful issue, for these are qualities which have been shared by most of the great inventors; but his views on the present and future condition of the chemical industries of the United States. For these conditions are not unlike our own, and we may well learn a lesson from one who by education and experience in the laboratory and in the works is so well equipped to speak with authority.

Dr. Baekeland points out that the country has enough capable chemists, but that there are conditions under which the best chemists cannot succeed, for success depends just as much on the kind of men who are at the business end of the new chemical enterprises. "It will certainly do no harm," he says, "to many of our new chemical enterprises if among their directors they have at least some chemists as well as purely business men or bankers and lawyers." "Why should a chemist," he asks, "if he is intelligent enough to master the most intricate problems of chemistry, not be able also to learn how to exercise enough common sense and good judgment to help to discuss and devise successful business policies?" He points out that all the largest chemical enterprises of the world have always had prominent chemists among their directors, and the policy of these enterprises has not been left entirely in the nands of a set of purely business men who remained wilfully ignorant of the essential technical parts upon which their enterprise was based. He refers also to the industrial part played by the German banks, who, with a staff of scientific advisers, have mastered the art of nursing new chemical industries.

A successful industry, he says, must be built upon sound scientific knowledge, which consists in the putting into practice principles of efficiency and introducing knowledge where ignorance formerly existed, with its usual accompaniments of waste and slovenliness. It does not mean merely dividends for its stockholders or wages for its workmen. Dr. Baekeland looks with considerable apprehension on the future of some of the ventures which are being started now by men who are merely trying to make money quickly, who look upon their chemists merely as temporary tools, and see in their enterprise only a pretext for realising their greedy ambitions.

Finally, Dr. Baekeland touches upon the educational question. He exonerates the chemist for the part that chemistry has been forced to play in the war by showing how war is ages older than science and has been born of greed, iniquity, and lust for power. It is the main inheritance of the aims and thoughts of the past, rendered respectable by a rather large share of our so-called classical literature, together with our awe for tradition, which keeps us in the cold, relentless grip of the wrong ethics of bygone ages.

J. B. C.

RECENT WORK ON GENETICS.

DR. L. DONCASTER'S work on sex-limited colour-inheritance in cats is well known to students of heredity, the typical "tortoiseshell" coat being almost always characteristic of a female. An account of the microscopic structure of a testis from a tortoiseshell male which after repeated matings failed to beget kittens is given by Dr. Doncaster and Mr. D. W. Cutler in the December number of the *Journal of Genetics* (vol. v., No. 2). The tubules were absolutely devoid of spermatocytes and spermatozoa, while the interstitial tissue which is supposed to be concerned with the secretion of the sexual hormones was exceptionally well developed. The belief that the rare tortoiseshell tom-cat is normally sterile is thus confirmed, though the records of breeders show that a fertile male of this colour has been known. The conclusion drawn, therefore, is the possibility that "the abnormal transmission of a sex-limited colour-factor to a male may sometimes cause the animal to be sterile, and in other cases not have this effect."

This number of the journal contains also an impor-

tant paper by Dr. E. A. Cockayne on "Gynandromorphism." Insects with the secondary sexual characters of both male and female variously combined in a single individual are favourite curiosities among collectors. Dr. Cockayne is able to describe the internal reproductive organs and the genital armature in several specimens of these abnormalities. He divides such insects into three groups:—(1) Genetic hermaphrodites, with both ovaries and testes and the genital armature of both sexes represented—these are often laterally divided into a male and a female half, though the symmetry is rarely exact; (2) primary somatic hermaphrodites, which have either ovaries or testes, but both male and female structures in the armature; and (3) secondary somatic hermaphrodites, unisexual as regards the whole reproductive apparatus, but with secondary characters of both sexes in the wings, feelers, or elsewhere. The great majority of the observed cases fall into the second of these divisions. Dr. Cockayne accepts the view that sex is a Mendelian unit character, and suggests that in the "halved" gynandromorphs there must be an irregular division of the sex-determining chromatin in the first cleavage of the zygote-nucleus, while in the other types there may be "a failure in the normal process of fusion of the sex-chromosomes of the spermatozoon and ovum" or "a difference in the potency of the factors for sex occurring in the two parents."

The heredity of bone-fragility in man is discussed by Profs. H. S. Coward and C. B. Davenport in Bulletin 14 of the New York Eugenics Record Office. From a number of family histories it appears that this condition (osteopsathyrosis) behaves as a Mendelian dominant often correlated with a blue colour in the sclerotic coat of the eye, but not complicated by special association with either sex-factor. A man and woman, both free from the condition, need not fear, therefore, that it can be transmitted through them to offspring, even though they may have brothers or sisters affected.

G. H. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

It is announced in the issue of *Science* for April 7 that Harvard University has received a bequest of 10,300*l.* from the estate of Mr. J. A. Beebe, and one of 10,000*l.* from the estate of Mrs. W. F. Matchett; the income of both is to be used for general purposes.

In the House of Commons on May 9, Sir Philip Magnus asked the Prime Minister whether, having regard to the general demand that had been expressed for an exhaustive inquiry into our present educational system, particularly with regard to the claims of science to occupy a more important place in the curriculum of our schools, he could make any statement as to the proposal for the appointment of a Royal Commission to consider and to report upon the question of the organisation of education in this country. In reply, Mr. Asquith said:—"When the Government are in possession of the results of the various inquiries they have set on foot it will be possible to decide whether any useful purpose would be served by setting up a Royal Commission."

The growing unrest in the minds of thoughtful persons on the subject of public education finds expression in a leading article of the current issue of the *Times* Educational Supplement, which, during the last twelve months, has consistently pleaded for a more liberal conception of the aims of education in the elementary school and of the necessary extension of the compulsory period of school attendance until the age of fifteen, so as to make effective for all children the elements at least of a secondary education from the age of eleven. As in many other matters of high importance, the events of the war have brought into clear vision many national shortcomings, not the least of which is to be found in the domain of education, alike in respect of means and method, subjects of instruction, the length of the school life, and the care of the adolescent. It is clear that the nation cannot hope to maintain and advance its position as a civilised Power of the first rank unless the mental and moral training of its future citizens receives the devoted attention of the best minds of the nation, whose advice and guidance shall be accepted independent of any merely pecuniary considerations. The issue is vital to the national well-being. Bodies like the Royal Society, the British Science Guild, the Teachers' Guild of Great Britain, various education authorities, and teachers' associations are all moving for an inquiry at the hands of men of high responsibility, eminent in the world of science and industry, and of men known for their devotion to the educational well-being of the nation. No mere departmental committee, however reinforced, will meet the grave responsibilities of the problems involved. Even in the stress of an unparalleled war—indeed, because of it—it is essential that immediate steps be taken to review our whole system of education and to find a remedy for the crying evils that beset it.

In an article in the current *Fortnightly Review*, by Mr. Archibald Hurd, we are invited to consider "The German Peril after the War," and its bearing upon the economic well-being of the British Empire. Much in the way of abuse is poured out upon the entire German nation, who are characterised as the "best-educated and most unmoral people of Europe, whose guile, lack of principle, and innate baseness we have only been in a position to comprehend since this war opened." When the war is over and victory has been achieved, "Germany with its vast population of from 60,000,000 to 70,000,000 will remain . . . with its vast resources organised, prepared to reassert its position in the world." We shall then embark upon an economic struggle scarcely less deadly in its effects than the war in which we are now engaged. It is admitted that German education—skill in applying the fruits of scientific discovery—energy, enterprise, and power of organisation have brought her into strenuous rivalry with Great Britain, but it has been accompanied apparently with a Machiavellian ingenuity of means and purpose unrivalled in the world's history. "Germany has had a monopoly in explosives, chemical dyes . . . and many other essentials of modern industry, including laboratory and optical glass." "Our sick could not be tended because she controlled essential chemicals," and "in a hundred and one trades Germany has had complete control." The trend of the article favours fiscal measures as the most effective palliative, yet at the same time the nation is urged to reform its system of education and to co-ordinate science and industry. The author, however, fails to realise the true source of Germany's great economic position, namely, her educational efficiency.

A White Paper issued on April 25 contains reports of the Advisory Committee on grants to Welsh universities and colleges, and of the Departmental Committee on the National Medical School for Wales, which were both made in 1914, and Treasury minutes thereon, one of which is dated April 18 last. This minute points out that a Royal Commission has now been appointed to inquire into the organisation and work of the University of Wales and Welsh colleges, and goes on to say that the Treasury is prepared to concur in the recommendations of the Advisory Com-

mittee on condition that the new grants will be applied, pending the reconstitution of the University, to meet existing liabilities and not for new developments. The allocation of the existing annual grants of 31,000*l.*, as well as of the new grants, will be liable to reconsideration after the reorganisation of the University. The Treasury has decided to include in the 1916–17 Estimates an additional sum of 5500*l.* for the first year of the new grants, provided the local authorities continue their contribution of 2000*l.* to the University College at Cardiff. The raising of a further sum of 3500*l.* out of rates, in accordance with the recommendation of the Advisory Committee, is waived until after the war. The Treasury will, however, feel bound to attach such a condition after the war. If that condition is complied with in future years, it will be prepared in addition to pay 500*l.* for each further 500*l.* raised by local authorities over and above 5500*l.* until the total additional grant from the Exchequer to the University and the colleges reaches the figure of 11,000*l.* per annum. The minute also states that the Treasury will be prepared in due course to give effect to the recommendation of the Departmental Committee that half the additional annual cost of maintaining the National Medical School at Cardiff, up to a maximum grant of 5000*l.* a year, should be paid by the Exchequer, on the conditions set out in the reports of the Departmental Committee.

THE plea for increased attention to science put forward in the memorandum, signed by thirty-six men of science, issued last February, referred particularly to the position of scientific subjects in the public schools and at Oxford and Cambridge, and to the marks obtainable, in comparison with classics, in the examinations for the highest posts of the public service. It appears to have been the deliberate purpose of the promoters of the memorandum to limit consideration to these points, which they believe to be of fundamental importance. In any case, a reform of the present attitude towards science shown by administrative officials and legislators might be started by making scientific subjects of capital importance in the examinations for appointments in Class I. of the Civil Services; and it is possible that there is practical wisdom in limiting attention to these aspects instead of surveying the whole field of education. As the object of the memorandum was to assert the claims of science to fuller recognition in the school and the State, it was not necessary to acknowledge the complementary part played by literary studies in a complete education; yet it is scarcely too much to say that none of the men of science who signed the memorial was unmindful of it. A letter which appeared in the *Times* of May 4, signed by several leading representatives of science, as well as of the humanities, suggests that the value of literary studies is being overlooked, while the claims of science are being urged. Science is tacitly classified as technical knowledge and necessary for national prosperity, but it is held that in the education "which will develop human faculty and the power of thinking clearly to the highest possible degree . . . the study of Greece and Rome must always have a large part." In other words, "early specialisation is injurious" if it means elementary science teaching, but not when, as at present, it signifies classical languages and literature. We do not believe for a moment that the best interests of classical and literary studies would suffer if science were given the place in the curriculum now occupied by Greek and Latin; for few pupils ever reach the stage of intelligent appreciation of works in these languages, and for the majority of them good translations in English would serve as useful a purpose as vague interpretations of classical texts.

SOCIETIES AND ACADEMIES.

LONDON.

Challenger Society, April 12.—Dr. G. H. Fowler in the chair.—E. T. **Browne**: The geographical distribution of Siphonophores. Nearly all the species are tropical, and only one (*Diphyes arctica*) has permanently established itself in cold water. Of ninety species recognised, seventy are common to the Atlantic and Indo-Pacific, and most of the remainder have been found in the Atlantic only.—C. Tate **Regan**: The distribution of the clupeoid fishes of the genus Sardina. The species inhabit the zones between the mean annual surface isotherms of 12° C. and 20° C. They are *S. pilchardus*, of Europe, *S. neopilchardus*, of Australia and New Zealand, and *S. sagax*, of South Africa, Japan, California, and Chile.

Royal Meteorological Society, April 19.—Major H. G. Lyons, president, in the chair.—E. V. **Newnham**: The persistence of wet and dry weather. The rainfall records of Greenwich, Kew, Aberdeen, and Valencia have been examined in order to find out how often rain falls on the day following successive runs of one, two, three, etc., wet or fine days. The common notion seems to be that after a long run of wet days the chance of a fine day becomes greater, but statistics do not support this conclusion. Generally speaking, the expectation of rain on any day has been found to increase rapidly as the number of previous successive wet days increases, and to diminish with the number of successive fine days in the past. After very long spells of either kind the expectation of further rain reaches a practically steady value. The same conclusion holds for the expectation of rain in a given hour after different runs of wet and dry hours. In illustration, some of the results may be quoted. At Valencia, after seven days of drought, rain falls on the eighth day twenty-four times out of one hundred, but after seven rainy days eighty-six times. For Kew the corresponding increase is rather less, namely, from twenty-seven to seventy-three.—Prof. H. H. **Turner**: Discontinuities in meteorological phenomena. In a former paper certain critical dates, about six years apart (and formed according to a specified law, apparently related to the movements of the earth's axis), were specified for 200 years back; and it was shown that a number of meteorological data changed abruptly in character at these dates. In simple cases the intermediate chapters are alternately hot and cold, or wet and dry, though other changes are more complex. In the present paper various new data are submitted to the same test and give confirmatory results. The most noteworthy case is that of the mean temperatures at Paris, which confirm the dates for the past century. The changes at the critical dates are shown to be abrupt; the alternation is consistent for seventeen chapters out of eighteen; and it is shown to vary in amount according to a law which suggests the regular action of two disturbing causes, one of which has already been shown to play an important part in these phenomena, and has a period of about forty years; the other, of about fifty years, appearing clearly in Mr. Douglass's measures of Californian tree-rings.

Mathematical Society, April 27.—Sir J. Larmor, president, in the chair.—Major **MacMahon**: Some problems of combinatory analysis.—Dr. S. **Chapman**: The uniformity of gaseous density, according to the kinetic theory.—G. N. **Watson**: Bessel functions and Kapteyn series.—T. C. **Lewis**: Four Tucker circles.—Prof. H. S. **Carslaw**: The Green's function for the equation $\nabla^2 u + \kappa^2 u = 0$ (II.).—J. **Hodgkinson**: The nodal points of a plane sextic.—S. **Pollard**: The deduction of criteria for the convergence of Fourier's series from Fejer's theorem concerning their summability.—Prof. W. H.

Young: Note on functions of upper and lower type.—Mrs. G. C. **Young**: The derivates of a function.

MANCHESTER.

Literary and Philosophical Society, March 21.—Prof. S. J. Hickson, president, in the chair.—Prof. F. E. **Weiss**: Recent views concerning the nature of so-called "graft hybrids." The author gave an account of the recent researches made on graft hybrids, describing, among others, the curious form of *Cytisus Adami*, obtained early last century by grafting the purple Cytisus on the yellow Laburnum, and the more recent productions resulting from grafting shoots of the tomato upon young plants of the nightshade. In this, as in the purple Laburnum, reversions to both parental forms are common. Other cases of so-called hybrids are known between the hawthorn and medlar, the quince and pear, and the almond and peach. A summary was given of the various views put forward to account for the production of these curious intermediate forms, and the relationship of the graft hybrids to ordinary seed hybrids was discussed.

April 4.—Prof. S. J. Hickson, president, in the chair.—Prof. G. Elliot **Smith**: The origin of the cerebral cortex. The cerebral cortex was called into existence during the process of evolution of the vertebrates, and, though difficult to detect in certain fishes, is to be regarded as a distinctive and inherent feature of vertebrate structure. The microscopic *formatio pallialis* of the Cyclostomes represents the undifferentiated rudiment of the whole of the pallium (hippocampal formation, piriform area, and neopallium of the highest vertebrates), and not merely the hippocampus. The cerebellum grew up around the central terminations of the nerves which bring into the nervous system special information concerning the animal's position in space; and its cortical mechanism developed in response to the need for bringing this information under the control of other influences, such as the nerves of vision, touch, the muscular sense, etc., before it is transmitted to the muscles of the body as a whole. The cerebral cortex grew up in a similar way around the central terminations of the olfactory nerve.—Prof. G. Elliot **Smith**: The commencement of the Neolithic phase of culture. Evidence pointed to the introducers of the Azilian culture as representing an early wave of the Neolithic people, coming probably from Africa into Europe. The author suggested that sporadic bearers of the same culture probably made their way into Europe for many centuries before the close of the Palæolithic epoch there. This would explain many similarities of Magdalenian to Azilian implements, and of both to those of Predynastic Egypt.—J. W. **Jackson**: The geographical distribution of the use of pearls and pearl-shells. The special appreciation of pearls is intimately associated with the geographical distribution of elements of a culture, including, amongst other things, the use of shell-purple for dyeing and of conch-shells for trumpets. Through Phœnician trade the knowledge of the pearl spread from the eastern Mediterranean *viâ* the Red Sea and Persian Gulf to India and Ceylon, China and Japan, Indonesia and the Pacific Islands, and, finally, the New World.—J. W. **Jackson**: The use of shells for the purposes of currency. No form of shell-money has been used so extensively as the money-cowry, *Cypraea moneta*, and this is used in a natural state. The date of the introduction of this cowry-currency is unknown, but it was in use in Egypt in Predynastic times. Shell-currency has been recorded from the Sandwich Islands, New Hebrides, and New Caledonia, and it was extensively used in China and on the Pacific coast of North America. Portuguese voyagers refer to its use in West Africa in the fifteenth century, and it is at present in vogue in tropical Africa.

PARIS.

Academy of Sciences, April 25.—M. Camille Jordan in the chair.—The president announced the death of M. Emile Jungfleisch, member of the Academy.—G. **Bigourdan**: Monthly distribution of average cloudiness in France. A discussion of observations from thirty-five stations in France and foreign stations close to the French frontier. In the scale adopted 0 indicates blue sky, and 10 a completely clouded sky, and the results are shown in thirteen charts, one for each month, and one for the yearly average, giving the isonephs, or lines of equal cloudiness. More observation stations are required before full conclusions can be drawn.—T. **Levi-Civita**: The regularisation of the problem of three bodies.—W. **Sierpinski**: A cantorian curve which contains a biunivocal and continuous image of any given curve.—E. **Baticle**: Calculation of the thrust on a supporting wall by a powdery mass with free plane surface.—Gabriel **Sizes**: Properties of the law of resonance of vibrating bodies.—J. **Deprat**: The structure of the internal zone of the preyunnan sheets.—Emile **Belot**: Contribution to the study of the causes of volcanoes. An experiment showing the production of a miniature crater by the action of locally applied heat to a mixture of water and sand, showing why the vapour is evolved at a considerable distance from the source of heat. Assuming a connection between volcanoes and the influx of sea-water, this explanation removes the difficulty of the South American volcanoes situated a considerable distance from the sea.—E. **Mathias**: Three observations of globular lightning made at the summit of the Puy de Dôme.—F. **Jadin** and A. **Astruc**: The manganese in some springs connected with the central massif and some stations in the plain of Languedoc. The amounts of manganese found vary between 0·001 and 0·4 mgr. per litre. The data confirm the conclusions given in previous communications on the amounts of manganese in French mineral waters.—Henry W. **Brölemann**: An evolutive process in Diplopod Myriapods.—E. **Kayser**: Contribution to the study of the ferments of rum. A study of the fermentation products produced from beetroot, molasses, and cane-sugar molasses by various yeasts. Figures are given for the higher alcohols, volatile acids, aldehydes, and ethers.—F. **Garrigou**: The hygienic, rational, and economical treatment of human excreta.—M. **Marage**: True and simulated deaf-mutism resulting from wounds received in battle. The medical examination of such cases should avoid experiments causing pain to the patient, and in the case of a painful treatment, involving possibly negative results, the consent of the patient should always be obtained.—H. **Busquet**: The rapid immunisation by small doses of nucleinate of soda, or chaulmoogra oil, against the hypotensive action of large doses of these substances.

BOOKS RECEIVED.

Statics: A First Course. By C. O. Tuckey and W. A. Nayler. Pp. 299. (Oxford: Clarendon Press.) 3*s*. 6*d*.

Historical Introduction to Mathematical Literature. By Prof. G. A. Miller. Pp. xiii+302. (London: Macmillan and Co., Ltd.) 7*s*. net.

The Principles of Agronomy. By Prof. F. S. Harris and G. Stewart. Pp. xvi+451. (London: Macmillan and Co., Ltd.) 6*s*. net.

The Influence of Ancient Egyptian Civilization in the East and in America. By Prof. G. Elliot Smith. Pp. 32. (Manchester: University Press; London: Longmans and Co.) 1*s*. net.

Annual Report of the Director, Kodaikanal and Madras Observatories for 1915. Pp. 24. (Madras: Government Press.)

An Intermediate Text-Book of Magnetism and Electricity. By G. F. Woodhouse. Pp. x+264. (Sedbergh: Jackson and Son.) 6*s*. net.

Canada. Department of Mines. Preliminary Report on the Mineral Production of Canada during the Calendar Year 1915. Nos. 348, 349, 350, 383, 408. (Ottawa: Government Printing Bureau.)

Spitsbergen Waters. Oceanographic Observations during the Cruise of the *Veslemöy* to Spitsbergen in 1912. By F. Nansen. Pp. 132. (Christiania: J. Dybwad.)

Proceedings of the Geological Society of South Africa. To accompany vol. xviii. of the Transactions. January-December, 1915. Transactions of the Geological Society of South Africa. Vol. xviii. Pp. 134+plates xvi. (Johannesburg.)

The Purpose of Education. By St. George Lane Fox Pitt. New edition. Pp. xxviii+144. (Cambridge: At the University Press.) 2*s*. 6*d*. net.

The Value of Science in the Smithy and Forge. By W. H. Cathcart. Pp. xiv+163. (London: C. Griffin and Co., Ltd.) 4*s*. net.

A Guerra E. O. Pensamento Medico. By Prof. R. Jorge. Pp. 63. (Lisboa: Sociedade das Sciencias Medicas.)

Department of Commerce. Scientific Papers of the Bureau of Standards. No. 274. (Washington: Government Printing Office.)

Imperial Department of Agriculture for the West Indies. Sugar-Cane Experiments in the Leeward Islands. Report on Experiments conducted in Antigua and St. Kitts in the Season 1914–15. Parts i. and ii. Pp. 76. (Barbados.)

Yorkshire's Contribution to Science, with a Bibliography of Natural History Publications. By T. Sheppard. Pp. 233. (London: A. Brown and Sons, Ltd.) 5*s*. net.

Cassell's Modern School Series. Historical Section. The Tale of Ancient Peoples. By A. E. McKilliam. Pp. 128. The Tale of the Nations. By A. E. McKilliam. Pp. 160. (London: Cassell and Co., Ltd.) 10*d*. net and 1*s*. net respectively.

The Practical Principles of Plain Photo-Micrography. By G. West. Pp. xii+145+plates viii. (Dundee: The Author, University College.) 4*s*. 6*d*. net.

Annuario publicado pelo Observatorio Nacional do Rio de Janeiro, 1916. Anno xxxii. Pp. vi+259. (Rio de Janeiro.)

DIARY OF SOCIETIES.

THURSDAY, MAY 11.

ROYAL SOCIETY, at 4.30.—Seventh Memoir on the Partition of Numbers. A Detailed Study of the Enumeration of the Partitions of Multipartite Numbers: Major P. A. MacMahon.—Legendre's Functions $P_n(\theta)$ when n is Great and θ has any Value: Lord Rayleigh.—The Occurrence of Gelatinous Spicules and their Mode of Origin in a New Genus of Siliceous Sponges: Prof. A. Dendy.—The Classification of the Reptilia: E. S. Goodrich.—The Experimental Production of Congenital Goitre: Dr. R. McCarrison.

ROYAL INSTITUTION, at 3.—Flints and Flint Implements: Sir Ray Lankester.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—*Discussion*: The Influence of the War on the Mining and Metallurgical Industries.

FRIDAY, MAY 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Surface Currents of Jupiter in 1915–16: S. Bolton.—Observations of V Cassiopeiæ in 1910–16: A. N. Brown.—The Certainty of the Canals of Mars: G. H. Hamilton.—The Illumination of the Field of a Photographic Objective: H. C. Lord.—The Law of Distribution in Star-clusters: J. H. Jeans.—The Efficiency of Sun Spots in Relation to the Mean Daily Range of Terrestrial Magnetic Declination: Rev. A. L. Cortie.—The Theory of Star-streaming and the Structure of the Universe. II.: J. H. Jeans.—The Distribution of Stars in Globular Clusters: A. S. Eddington.—Stars with Large Proper Motion between Declination 65° and the North Pole: Royal Observatory, Greenwich.—Solar Prominence in 1915: G. J. Newbegin.

PHYSICAL SOCIETY, at 5.—The Latent Heats of Fusion of Metals and the Quantum Theory: Dr. H. S. Allen.—(1) Lenses for Light Distribution; (2) The Choice of Glass for Cemented Objectives: T. Smith.

MALACOLOGICAL SOCIETY, at 7.—Descriptions of New Mollusca: G. B. Sowerby.—Solander as a Conchologist: T. Iredale.—Misnamed Tasmanian Chitons: T. Iredale and W. L. May.

SATURDAY, MAY 13.

ROYAL INSTITUTION, at 3.—X-Rays and Crystals: Prof. W. H. Bragg.

MONDAY, MAY 15.

ARISTOTELIAN SOCIETY, at 8.—Symposium at Oxford—The Theory of the State: Hon. B. Russell, S. Ball, C. D. Burns, and G. D. H. Cole.

ROYAL SOCIETY OF ARTS, at 4.30.—Vibrations, Waves, and Resonance: Dr. J. Erskine-Murray.

TUESDAY, MAY 16.

ROYAL INSTITUTION, at 3.—Unconscious Nerves—their Functions in Internal Life: Prof. C. S. Sherrington.

ROYAL STATISTICAL SOCIETY, at 5.15.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Petroleum Refining: A. Campbell.

WEDNESDAY, MAY 17.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Re-adjustment of Pressure Differences—Two Species of Atmospheric Circulation and their Connection: L. C. W. Bonacina.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Some Suggestions regarding Visual Efficiency in the Use of the Microscope and other Optical Instruments: J. W. Purkiss.—A Case of Apparent Intelligence exhibited by a Marine Tube-bearing Worm, *Terebella conchilega*: A. T. Watson.—Alien Oligochæts in England: Rev. Hilderic Friend.

ROYAL SOCIETY OF ARTS, at 4.30.—Hindu Hand-painted Calicoes of the Seventeenth and Eighteenth Centuries, and their Influence on the Tinctorial Arts of Europe: G. P. Baker.

THURSDAY, MAY 18.

ROYAL SOCIETY, at 4.30.

ROYAL INSTITUTION, at 3.—Flints and Flint Implements: Sir Ray Lankester.

FRIDAY, MAY 19.

ROYAL INSTITUTION, at 5.30.—The Movements of the Earth's Pole: Col. E. H. Hills.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Spur-Gearing: D. Adamson.

SATURDAY, MAY 20.

ROYAL INSTITUTION, at 3.—The Finance of the Great War—New Problem and New Solutions: Prof. H. S. Foxwell.

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THURSDAY, MAY 18, 1916.

MIMICS READY-MADE.

Mimicry in Butterflies. By Prof. R. C. Punnett. Pp. vi+188+xvi plates. (Cambridge: At the University Press, 1915.) Price 15*s.* net.

THE scope and general arrangement of this work are indicated in the following list of its eleven chapters: (i.) A short introduction on teleological interpretations—theological and otherwise; (ii.) A historical account of Batesian and Müllerian mimicry; (iii.) Old-world mimics, with a very poor reproduction on p. 19 of Dr. Eltringham's illustrations of the fore-feet of butterflies; (iv.) New-world mimics; (v.) Criticisms of "the five conditions which Wallace regarded as constant for all cases of mimetic resemblance"; (vi.) "Mimicry rings," a discussion on the origin of mimetic resemblances and initial steps; (vii. and viii.) On *Papilio polytes*—the Mendelian relationship between its female forms and their origin; (ix.) The enemies of butterflies; (x.) Mimicry and variation; (xi.) Conclusion, summed up in the last words—"The facts, so far as we at present know them, tell definitely against the views generally held as to the part played by natural selection in the process of evolution"—viz., against the theory that adaptations are built up by the gradual accumulation of small variations.

The last chapter is followed by two appendices, the first containing a table by Mr. H. T. J. Norton giving the means for "estimating the change brought about through selection with regard to a given hereditary factor in a population of mixed nature mating at random"; the second explaining the differences between the three sections of Papilio, and giving a list of Papilionine models and mimics quoted in the text.

The principal feature of the book is its illustration by means of twelve excellent coloured and four uncoloured plates. There are unfortunately a good many errors and much want of judgment in arrangement and in some of the examples selected.

In so complicated a subject as mimicry it is a great help to the reader to adopt some uniform system in the arrangement of models and mimics, and for many years it has been a usual custom when the figures are side by side to place the mimic to the right; when they are one above the other, to give it the lower place. The present work adopts no system at all. Sometimes, as in plate vii., the mimics are to the right; sometimes, as in viii. and xv., they are to the left; and so with upper and lower.

There are also unfortunate errors in the naming. Fig. 3 on plate i. is certainly not *Danais septentrionis*, but a Radena, probably *R. vulgaris.* The former butterfly is nearly represented by the closely allied *D. petiverana,* shown on plate vi., fig. 1. A still more serious mistake occurs on this last plate, where the names of figs. 2 and 3 are transposed in the description and in the text, so that a Danaine model is made to bear the name of the Papilionine mimic of another model, and *vice versâ.* Apart from this, the model shown in fig. 2, if only one was to be figured or mentioned in the text, is not well chosen, and it is natural that the author should, on pp. 29, 30, criticise his own selection. *Amauris echeria* and *albimaculata* are the well-known models of the *brasidas* form of *Pap. leonidas* in the south and south-east parts of its range. The same Danaines are also deprived of their true place as the models of *Pap. echerioides,* being ousted by *Am. psyttalea* in the table on p. 159.

The descriptive title of plate xii., "South American Butterflies," is unfortunately chosen, for the lowest of the four figures is a moth, and the word "Butterflies" in conspicuous capitals immediately beneath the figure quite overshadows the diminutive "(Heterocera)" at the side. Plate xv., "illustrating the closely parallel series of patterns occurring in the two distinct groups Heliconinæ and Ithomiinæ," is unfortunate, both in the names and in one of the genera selected—Mechanitis. If a single Ithomiine genus was to be shown with Heliconius, it should have been Melinæa, the undoubted primary models of the Heliconines and almost certainly of the species of Mechanitis as well. The resemblances shown on plate xv. are, in fact, the secondary or incidental resemblances between species that mimic the same models—not themselves illustrated. As regards the names, it is perhaps too much to expect a writer whose main interest is bionomic and evolutionary to follow all the ups and downs of synonymy. But the examples are not numerous, and it is easy to get assistance from friends devoted to the study of systematics. Furthermore, most of the examples on plate xv. had already been figured and named in the excellent, although uncoloured, plates xxx.–xxxiii. of J. C. Moulton's paper in Trans. Ent. Soc., 1908. Of the five species of Heliconius figured on plate xv., fig. 1, *mirus* is regarded as a form of *novatus*; fig. 2, *telchinia,* of *ismenius*; fig. 3, *eucrate* has been long known as *narcaea narcaea*; fig. 5, "*splendens,*" a name unknown in the genus (*splendida,* Weym., does not resemble the figure), is *aristiona bicolorata.* Fig. 10, *Mechanitis "methona"* is doubtless intended to be *M. deceptus,* the true co-mimic of the accompanying Heliconius (fig. 5); but a butterfly from a different association and from farther north, *M. messenoides,* has apparently been figured—either this or a form transitional between it and *deceptus.* "*Methona*" is a third rendering of Hewitson's *mothone*, Salvin having introduced a second rendering, "*methone*"; but the butterfly originally named by Hewitson is a Melinæa, and not a Mechanitis at all.

Plate xvi. and the corresponding parts of the text suffer from the omission of a third North American Danaine from Arizona, *D. strigosa,* and the corresponding Limenitis, *L. obsoleta* (*hulsti*), which, although an excellent mimic,

retains more of the pattern of the non-mimetic species than its two mimetic relatives, *L. archippus* and *L. floridensis* (*eros*). The structural features, worked out by Dr. Eltringham, also confirm the conclusions derived from pattern, and should have been taken into account in any useful discussion of North American mimicry.

Criticisms suggested by the illustrations have occupied nearly the whole of the available space, and it is impossible to write on the present occasion of the numerous errors contained in the text or to discuss the various arguments advanced by the writer. One general criticism may, however, be made. If we desire, as the author desires, by the study of mimicry to throw light on the course of evolution in general, we must at any rate glance at mimicry between insects of different orders as well as the likeness between butterfly patterns; for a hypothesis which attempts to explain the latter but cannot explain the former is not only of limited interest, but also unlikely to provide a true interpretation in its own province.

E. B. P.

THE GROWTH OF THE MIND.

(1) *Child Training: a System of Education for the Child under the School Age.* By V. M. Hillyer. Pp. xxxix + 299. (London: Duckworth and Co., 1915.) Price 5*s.* net.

(2) *The Foundations of Normal and Abnormal Psychology.* By Dr. B. Sidis. Pp. 416. (London: Duckworth and Co., 1915.) Price 7*s.* 6*d.* net.

(1) TO stimulate educational ideas is a most valuable social service, but the necessity of using the method of trial and error in the application of this or that principle to the teaching process may come hard on the child, who must submit to be a *corpus vile* for experimentation. The co-operation of teachers and psychologists has produced many futile and even mischievous "theories of education," and the younger the subject the more dangerous is their practical incidence. But this co-operation has recently begun to justify itself. Teachers with insight, especially in America, have been applying certain approved results of psychology, and their success has been considerable. It is interesting to note that several old-world methods are still found to be among the best; for instance, the two main principles of savage education, imitation and "helping" the parents, and the classical and mediæval insistence upon drill, are proved foundations of training, especially in the case of the very young. A system like that of Mr. V. M. Hillyer is practical in the best sense, and soundly based on psychological fact. "It aims to avoid the faults so common in child training—sentimentality, effeminacy, emotionalism, mysticism, licence under the guise of freedom, exaggeration of the unimportant or trivial, the attaching of imaginary value to the symbolic." "The formation of *habits*, physical, mental, and moral," by direct drill is the keynote of the system. Mental training, for example, depends on the formation of "brain paths" by repetition, and on their increase in number by increasing associations.

The author well remarks: "It is a commonplace in education to say that the forming of character is the chief aim, that it is not so much what is learned, as the character produced, but character is nothing more than the sum total of habits—good or bad," and these are not only moral, but physical and mental. "Habits are formed by repetition, and in no other way than by repetition." It is very sensible to say, "the involuntary habits we can form by making the right *setting* for the child. His playmates, nurses, and, not least, his parents, will be his involuntary copies, models, and habit-formers. The voluntary habits we can form only by *practising* the child; they cannot be formed by *telling* him." Muscle-memory must be exercised, and reaction must be encouraged; on these lines concentration and speed may be developed. It is perhaps claiming too much to say: "If you stimulate and exercise the brain cells properly you can develop almost any habits, abilities, tastes, faculties you may wish." With young children there is a danger from excessive drill, which may induce fatigue, misconstrued so often by the inexperienced teacher, and from excessive habituation, which confines the child in a rut from which he may never escape. In this case his work lacks both individuality and finish.

If carried out with sympathy and intelligence, Mr. Hillyer's system is excellent. Not the least of its positive features is the drill in *social* habits.

(2) Dr. Boris Sidis makes a timely protest against "practical pseudo-psychology," and those psychologists "who claim that they have some great psychological truths to reveal to business men, manufacturers, and working men." He also presses the current objection to the use of physical terms and metaphors in the illustration of psychical phenomena, *e.g.*, when Kovalevsky expresses mental activity in terms of mechanical energy, "the writer might as well attempt to change inches into pounds. He who undertakes the examination and study of mental phenomena must bear in mind the simple and important, but frequently forgotten truth, that facts of consciousness are not of a physical, mechanical character."

A disciple of William James, the author attacks the so-called "new psychology" in its attempt to make psychology a physical science. But his very lengthy argumentation on the scope and function of the science of mind is extremely nebulous, and consists more of illustrative phrases than of illustrative facts. For example, the axiom that "psychological facts cannot be reached by any of the sense organs" is discussed and illustrated in about fifty pages without any new light being thrown on the thesis. "Nothing," says Dr. Sidis, "gives me more pleasure than to find myself in accord with the great American psychologist and philosopher (James)." This is in reference to his own theory of "reserve energy."

Another theory of the author, that of "moment consciousness," may be described, in view of its

lengthy presentation, as, in James's phrase, "the elaboration of the obvious." The author says of Freud: "Of course, the claims of that school to originality and to the apparent unveiling of the causation of psychoneurosis are entirely unjustified." But he does not attempt except by repetition of phrase to disprove the conception, *e.g.*, of *das Unbewusste* as suppressed unconscious sex-complexes.

A. E. Crawley.

AN INDIAN BIRD CALENDAR.

A Bird Calendar for Northern India. By Douglas Dewar. Pp. 211. (London: W. Thacker and Co., 1916.) Price 6*s.*

MR. DEWAR is well known to the Anglo-Indian public, and to a good many people over here, as the writer of a number of popular books, which, with a lively and trenchant style, combine a great deal of original observation and a very iconoclastic tendency towards the tenets of biological orthodoxy. The present book shows that he is well capable of handling his favourite subject in quite a different way; controversial matters are left on one side, and the style, though eminently readable and full of descriptions which bring the natural surroundings of the birds vividly before the mind's eye, is much more matter-of-fact as a rule than in the author's previous writings.

There is, indeed, so much to record in Indian bird-life from month to month, that to do it the justice that Mr. Dewar does leaves very little room for anything but the statement of ornithological events. It need scarcely be said that Anglo-Indian naturalists will appreciate a book like this, which, in a compact and handy form, puts before them the leading events of the ornithological year in northern India—the courtship, breeding, and plumage changes of the various species, and the arrival and departure of the numerous migrants; not only of visitors from the colder climates from the north, but of birds which move about locally in India, from the hills to the plains, and from one province to another, a limited form of migration which has been far less studied than the more sensational movements familiar in temperate climates. This will, however, no doubt in time be found to throw much light on the larger and, to most people, more familiar migrations; and for this reason, if for no other, the book deserves careful study by ornithologists not directly concerned with the Indian fauna.

The birds of India, and of the North-west Provinces especially, are indeed particularly well suited as a study to those ornithologists who aim at knowledge more scientific than can possibly be attained by a study of European, or, indeed, Palæarctic, birds only. The study is not too discouraging, for many of the birds are the same, though as a rule these naturally are mostly winter migrants; and numerous species exist belonging to European groups, though very distinct from our forms.

These, again, are differently distributed proportionally; Mr. Dewar has, for instance, several species of familiar cuckoos, kingfishers, and starlings—mynahs in Hindustani—to tell us about, as opposed to the single species of these families which we have in England, while of the thrushes and finches, such abundant birds over here, there is little for him to say. Notable, too, is the abundance and variety of the birds of prey and waterfowl, now so rare, comparatively, both in individuals and species, over most of Europe and especially in Britain; their continued abundance in India, even in the cultivated portions, showing that it is the aggressiveness of the European towards wild life, rather than the exigencies of cultivation, that has reduced them here. F. F.

OUR BOOKSHELF.

Engineering Geology. By Profs. H. Ries and T. L. Watson. Second edition, enlarged. Pp. xxvii+722. (New York: J. Wiley and Sons, Inc., 1915.) Price 17*s.* net.

The issue of a second edition less than eighteen months after the first would seem to indicate that this book is meeting with a favourable reception. The new volume is larger than the earlier by some 50 pages, the addition consisting of an eighteenth and concluding chapter on historical geology. Since the authors attempt to deal, in this limited space, with the nature and use of fossils, the classification of geological time, the characters and distribution in North America of the several systems, and their economic products, the treatment is necessarily very brief and the descriptions meagre. Nevertheless, the addition of the chapter is a decided improvement, inasmuch as it provides, in what might be the only geological text-book of an engineering student, some information, at least, as to the principles, methods, and outstanding facts of stratigraphy.

The first seventeen chapters remain practically as in the original edition. They deal in order with rock-forming minerals and rocks, rock-structures and metamorphism, rock-weathering and soil formation, the accumulation movements and effects of overground and underground waters, and with the principal geological materials used by the civil engineer or sought by the mining engineer. In view of the importance, to these engineers, of a thorough grasp of the meaning, methods of construction, and utility of geological maps and sections, the treatment of this part of the subject seems inadequate. In future editions it might be expanded with advantage.

The list of references to literature at the end of each chapter has been brought up to date, and will prove helpful when further information on special subjects is desired.

The book is probably the best available exposition of geology from the engineering point of view. C. G. C.

Electrical Apparatus-making for Beginners. By A. V. Ballhatchet. Pp. 164. (London: P. Marshall and Co., n.d.) Price 2s. net.

THE author has provided, at a moderate price, a very useful little book, which should do much to encourage the beginner to construct simple electrical apparatus with which to make a number of instructive experiments. The book is illustrated with a number of photographs of the apparatus described, which the author has himself constructed. In addition, there are good working drawings and diagrams of connections where these are helpful. The real utility and educational value of work of this kind to the beginner cannot be insisted upon too often. He has read of and perhaps seen professionally made apparatus, and he naturally supposes that nothing within his constructive power can be any good, and more especially is this the case if he is not already fairly accomplished in the use of tools. While his earlier efforts may not be much use to anybody else they are of immense value to him—that is, if he has any perseverance. He may gradually come to learn that rough-looking apparatus may really work up to a point well, and so begin to acquire that confidence in himself which is essential when, at a later stage, he has original ideas. He may then either make preliminary rough experiments to see if, with better work, they promise to succeed, or if he has become a good manipulator he may have discovered that he can carry out his own ideas quickly and with sufficiently good work in the essential parts to get better results than he could hope for if he depended entirely upon others to put his ideas into form. C. V. B.

Guida allo Studio della Storia delle Matematiche. By Prof. Gino Loria. Pp. xvi+228. (Milano: Ulrico Hoepli, 1916.) Lire 3.

THE plan of this work is rather unusual, but quite good. The first part gives, among other things, references to first-rate works on history and historical method in general (*e.g.* Bernheim, Lavisse et Rambaud, Merz), besides works on the history of mathematics in particular. We also find here summaries of the contents of the more important journals dealing with mathematical history. The second part is more specialised; there are sections on manuscripts, biographies, editions of collected works, mathematical correspondence, bibliography, catalogues, and so on. There is a name-index for each part separately. The amount of information given is really remarkable, and it is well up to date; the author, too, has not shrunk from the disagreeable duty of pointing out works (such as those of Montucla, and even of M. Cantor) which must be used with caution.

There are a good many misprints, especially in English names and words (Raleigh, for instance, *passim*); we even find our familiar friend Bernouilli (p. 166); but few, if any, are serious, and the wonder is that they are not more numerous than they are.

G. B. M.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Suggestion with regard to Genera Splitting.

INDIVIDUAL systematic botanists and zoologists differ much in the principles which guide them with regard to the "splitting," or "lumping," of genera. Much can be said on both sides. The splitting into smaller genera of a genus overloaded with species should help to show the more intimate relationships of the species to each other. On the other hand, if the new genera have names unlike the original genus, the kinship of all the species originally included in the one genus is, to the casual observer, more or less masked. When a genus is very small in species a better grasp of their relationship with each other is probably gained by retaining them all under one generic name, even though morphological characters may well warrant placing each species in a distinct genus. In botany in Australia several hundred species are included in the genera Eucalyptus and Acacia. Unquestionably a better grasp of the kinship of the individual species is obtained by leaving all in the two genera named rather than in instituting new genera for various groups, but it is equally certain that some day a "splitting" systematist will erect new genera, which will not, I believe, help us in "memorising" the groups as wholes.

Some time ago, in discussing this question with my friend, Mr. G. M. Matthews, whose valuable work on the "Birds of Australia" is now in the press, I suggested that the letters of the Greek alphabet should be used, when genera splitting is decided on, as a prefix to the original generic name, thereby showing the common relationship of all the species to each other. May I make this suggestion here in your columns, and add, further, that the relationship would be still more clearly shown if the Greek symbol were used rather than a "translation" into English? The original genus (*i.e.* the "split" part, containing the original type species) would be best represented as α, though difficulty would arise in thus altering the original generic name; so, unless zoologists and botanists could come to some international agreement on the matter, it would probably be necessary to use no prefix in this portion of the "split," but add (*S.S.*=*sensu stricto*) to the simple generic name. The "splits" could then be β, γ, etc. To take the genus Eucalyptus, for example, we should have α-Eucalyptus, or Eucalyptus (*S.S.*), β-Eucalyptus, γ-Eucalyptus, etc. Such a method of splitting would be convenient and handy, would still show the broader relationships of the species, and would not interfere with those systematists who disapprove of splitting, since these need only drop the prefix. J. BURTON CLELAND.

Department of Public Health,
Sydney, Australia.

The Place of Science in Education.

THE question as to whether modern education should be classical and literary, or scientific, is one which apparently, in certain high quarters, is still controverted. This matter, once said John Stuart Mill, is very much like a dispute "whether a tailor should make coats or trousers." Replying in the philosopher's own words, "Why not both? Can anything deserve the name of a good education which does not include literature and science too? If there were no

more to be said than that science teaches us to think and literary education to express our thoughts, do we not require both?" Most reasonable people would probably be prepared to concede the soundness of Mill's opinion. Is not therefore the educational system of a country which concerns itself in no way as to the status of science altogether imperfect and lopsided? The educational value of science was excellently assessed nearly half a century ago by the distinguished author of the words above quoted, in the following terms (*vide* Rectorial Address, St. Andrews University, 1867):—

"But it is time to speak of the uses of Scientific Instruction: or rather its indispensable necessity, for it is recommended by every consideration which pleads for any high order of intellectual education at all.

"The most obvious part of the value of scientific instruction, the mere information that it gives, speaks for itself. We are born into a world which we have not made—a world whose phenomena take place according to fixed laws, of which we do not bring any knowledge into the world with us. In such a world we are appointed to live, and in it all our work is to be done. Our whole working power depends on knowing the laws of the world—in other words, the properties of the things we have to work with, and to work among, and to work upon. . . .

"It is surely no small part of education to put us in intelligent possession of the most important and most universally interesting facts of the universe, so that the world which surrounds us may not be a sealed book to us, uninteresting because unintelligible. This, however, is but the simplest and most obvious part of the utility of science, and the part which, if neglected in youth, may be the most easily made up for afterwards. It is more important to understand the value of scientific instruction as a training and disciplining process, to fit the intellect for the proper work of a human being."

Since Mill's day there have been many realisations and warnings that those in charge of the country's affairs were not maintaining its position in the international scale of scientific efficiency, the probable contingent future effects being at the same time pointed out. The Government have no doubt always listened respectfully to the representations, emanating from conviction, that have from time to time been made to them, but, having no thoroughly intelligent apprehension, the central fact remains—they have done nothing. The country, in a matter vital to its welfare, has been allowed to fall back while parliamentary gentlemen have occupied themselves, and the minds of the majority of their fellow-countrymen, with domestic questions of only accessory, not essential, importance.

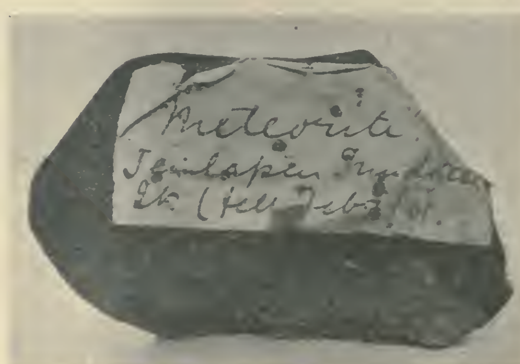
How can matters be remedied? In what possible way can progress in the future be ensured? Experience does not readily incline one to the belief that any number of memorials, deputations, or advisory boards will be able adequately to effect the greatly desired result. Would it not be an excellent thing and solve many difficulties were there a body of scientific opinion in the House of Commons? An old teaching of Bagehot's was that any notion, or creed, which could get a decent number of English members to stand up for it, might be a false, and, indeed, pernicious, opinion, but it was felt by nearly all Englishmen to be at all events possible—an opinion within the intellectual sphere, and to be reckoned with. And it was an immense achievement. This, of course, means that scientific men would require to stand as candidates for election to Parliament. The assertion that in general their very specialised scientific training would disqualify them from being useful participators in the ordinary business of the Legislature appears quite unfounded.

To the writer the foregoing suggests itself as one likely solution of our difficulty. The country, in an educational sense, appears to have got somewhat out of adjustment with external national requirement. Equilibrium with environment is, perhaps, not always easy of maintenance, but it is worth continually striving after, so far as is humanly possible; for, without this, insidiously begin the multifarious processes of destruction compassing an end which it is never possible precisely to define. D. Balsillie.

St. Andrews, April 30.

A Mysterious Meteorite.

The photograph here reproduced is of a meteoritic stone which was recently obtained by Mr. A. S. Kennard from a curio-dealer in Beckenham, Kent. All that could be discovered of its history was that it had



been purchased at the sale of the effects of a local auctioneer named Harris. Hitherto also all efforts definitely to fix the locality given on the label have failed. Any help in the solution of the mystery will be welcomed by me. G. T. Prior.

Natural History Museum, South Kensington.

THE RELIEF OF THE SHACKLETON ANTARCTIC EXPEDITION.

As the middle of May has been reached without news of the *Endurance*, action for the relief of Sir Ernest Shackleton's expedition has to be taken on the expectation that there will be no further news this season. It is possible that the *Endurance*, damaged and short of coal, may still be slowly working her way northward, and that any day we may hear of her return to South Georgia with perhaps the whole of the expedition on board. But such a solution of the difficulty must be regarded as highly improbable, and the relief expedition must be prepared with the information already available.

The more detailed news received from the *Aurora* encourages the hope that she can be refitted in New Zealand and entrusted with the relief work necessary on the Australasian side of the Antarctic. If so, the problem there is comparatively simple. The main anxiety in regard to that section of the expedition is due to the fact that when the *Aurora* was blown out to sea there had been no news of the depôt-laying parties for two months. Three sledge parties had started at the end of January, 1915, from the *Discovery* Hut at the southern end of Macmurdo Sound. Some depôts were successfully laid on the Ice Barrier.

By March 11 these depôt parties had been reorganised by Captain Macintosh, who went south again to continue this work. The *Aurora*, after great difficulties, took up winter quarters opposite the 1910 hut at Cape Evans. After a stay there of nearly two months she was carried out to sea on May 6 and drifted, imprisoned in the ice, all through that winter and the succeeding summer. She was only released on March 10, 1916, when, even if she had been undamaged and had had adequate stores, it would have been too late to return to Macmurdo Sound that season. The *Aurora* had no news from Captain Macintosh between March 11 and May 6, but there seems no serious cause for anxiety. He would probably have spent the rest of March and the early part of April depôt-laying, and the bad weather at the end of April may explain his failure to communicate from Hut Point to Cape Evans. The men left ashore on Macmurdo Sound have the choice of three huts, and have ample stores for the two winters which they have had to spend there; and there would be plenty also for Sir Ernest Shackleton's party if it has succeeded in its journey across the Pole.

Proposed routes of the Shackleton expedition.

All that is necessary on the Ross Sea side is the dispatch of a ship from New Zealand in November or December to pick up the men left ashore at Macmurdo Sound and find what news there may be of the transcontinental party. As to the success of this relief expedition there need be no doubt, for no attempt to reach Macmurdo Sound has yet failed.

Regarding the opposite side of Antarctica, in the Weddell Sea area, there can be no such confidence, for the normal ice conditions there appear to be as unfavourable as those in the Ross Sea are favourable. The plans for search in the Weddell Sea must recognise at least three distinct possibilities.

(1) Sir Ernest Shackleton may have succeeded in establishing a land base where he hoped to winter, and thence started overland to the Ross Sea, while two sledge parties may have explored westward to the base of Graham Land peninsula and eastward to the south of Coats Land. The *Endurance* may have failed to return either in consequence of waiting for one of the two sledge parties, or by the packed condition of the ice in the Weddell Sea.

(2) The landing may have been effected so late, or so much further north than was intended, as to leave no chance of success for the transpolar sledge journey. Sir Ernest Shackleton, with his usual capacity for the quick realisation of facts, may have decided to devote all the resources of the expedition to research in the vast unknown area beside the Weddell Sea. In that case all the three sledge parties should have returned to the winter quarters, though any one of the three may have failed to get back, and thus have delayed the return of the *Endurance*.

(3) It would, however, appear quite possible, since the Weddell Sea has been so seldom found to be navigable, that the *Endurance*, in the effort to force her way to the land, may, like the *Belgica*, have been caught in the ice, and the whole expedition may be still on board drifting in the floes.

It is obvious that it is impossible to decide between these three possibilities with the information at present available, though from the news received as to the conditions of the ice in the Weddell Sea during the last two seasons it is highly probable that Sir Ernest Shackleton may not have been able to effect his desired landing. He may have been forced to land on north-eastern Coats Land. The *Endurance* may then have been car-

ried away from the winter quarters, and the relief expedition ought to be able to search independently for the ice-bound *Endurance* and for the party or parties left on shore. There would obviously be a much better chance of success if two vessels could be employed—one to search the coast-lands, and the other to scour the sea along the probable lines of drift of the Weddell Sea pack. From the observations of the *Scotia* in the Weddell Sea the prevalent wind direction there appears to be from the east, so that some belt of "land water" may be fairly persistent off Coats Land and the drift of the ice may be westward; but knowledge of meteorology in the Weddell Sea is so scanty that forecasts as to the usual drift of the ice would command but little confidence and may be falsified by an unusual season. The commander of the relief expedition should be at liberty to select his own route.

Sir Ernest Shackleton has met with very bad luck from the weather. His proposed transcontinental sledge journey was a daring and difficult undertaking. He had, however, considered all its possibilities, and it promised a fair chance of success; but his plans may have been deranged at the outset by the exceptionally unfavourable season. The ice conditions in the Weddell Sea may have prevented his starting forth on his great adventure. No time must be lost in organising the expedition to take him the help which he and his colleagues may sorely need. In addition to the return of the *Aurora* to Macmurdo Sound, two vessels, if possible, should be sent to the Weddell Sea, for the area that will have to be searched is vast, the clues are uncertain, and the season is short.

THE APPLICATION OF MATHEMATICS TO EPIDEMIOLOGY.

It may seem remarkable that serious attempts to elucidate the mysteries of epidemic disease with the help of mathematical methods should only have been made within the last sixty years, and, even when made, should have been confined to the efforts of a very small number of students. In the seventeenth and early eighteenth centuries, the school of which Borelli was the most famous exponent endeavoured to bring much less promising medical fields under mathematical cultivation, while Sydenham's exposition of the principia of epidemiology would, one might have thought, have suggested to the founders of our modern calculus of probabilities that here was indeed an opportunity for them. No doubt, however, the explanation is to be found in the absence of statistical data, without which mathematical mills are forced to stand idle. It is of interest to recall the fact that the solution of a problem which took its rise in the failure to publish certain detailed statistics reveals a method which might have been generalised. We allude to Daniel Bernoulli's work on smallpox.[1]

His solution was as follows:—

If x denote the age in years, ξ the number who survive at that age out of a given number born, s the number of these survivors who have not had smallpox, and if in a year smallpox attacks 1 out of every n who have not had the disease, while 1 out of every m attacked dies, then the number attacked in element of time dx is sdx/n and we have:—

$$-ds=\frac{sdx}{n}-\frac{s}{\xi}\left(d\xi+\frac{sdx}{mn}\right) \text{ or } \frac{sd\xi-\xi ds}{s^2}=\frac{\xi dx}{ns}-\frac{dx}{mn}.$$

Substituting q for ξ/s, we have $dq=\frac{mq-1}{mn}dx$, so that $n \log(mq-1) = x + \text{constant}$, and ultimately, since when $x=0$, $s=\xi$,

$$s=\frac{m.\xi}{(m-1)e^{\frac{x}{n}}+1}.$$

This investigation contains the germ of a method which, as Sir Ronald Ross has brilliantly demonstrated, might be applied to the study of the succession of cases in an epidemic. Nobody, however, took the hint, and the real history of mathematical epidemiology begins with Farr, whose work on these lines has been made familiar to the present generation by Dr. John Brownlee. Modern researches fall into one of two classes. On one hand, those directly or indirectly inspired by the epoch-making discoveries of Prof. Karl Pearson in the theory of mathematical statistics; on the other, the independent investigations of Sir Ronald Ross.

Prof. Pearson's development of a family of frequency curves, including the Gauss-Laplace or normal curve as a particular case and capable of describing effectively distributions very far indeed from normal, enabled statisticians to deal with a wide range of frequency systems, and it naturally occurred to some to use this method in the study of epidemics. Frequency curves have been fitted by Brownlee,[2] Greenwood,[3] and other medical statisticians to different epidemics, the most extensive work in this direction having been that of Brownlee. Much of this work was descriptive; that is to say, the object was in the first place to graduate the statistics, and, if possible, to classify epidemics on the basis of the type of curve found. So far as graduation is concerned, the results have been fairly satisfactory, but it proved to be impossible to effect any useful classification, the only result that emerged being that Pearson's Type IV curve was more commonly encountered than any other. The more fundamental problem of epidemiology, viz., that of discovering the law of which the epidemic, whether viewed in its temporal or spatial relations, is an expression, could scarcely be solved in this way. Brownlee, however, was by no means content with the mere graduation of statistics. Following Farr, he surmised, for reasons explained in his papers, that the theoretical curve of an epidemic in time or space should be normal, and that any practical departure from normality should be susceptible of an explanation capable of expression in terms of a function of the

[1] See Todhunter's "History of the Theory of Probability," p. 225.

[2] Proc. Roy. Soc. Edin., 1906, xxvi., 484; *ibid.*, 1911, xxxi., 262.

[3] *Journ. Hygiene*, 1911, xi., 96; Proc. 17th Inter. Congress Med., 1913, Sect. 18.

normal function. By supposing that a constant of the theoretical normal curve, viz., its standard deviation, was itself a variable, and assuming for the latter a convenient form, he succeeded in obtaining a curve which effectively described certain symmetrical epidemics.

Brownlee did not, however, obtain any function which satisfactorily accounted for the marked asymmetry which characterises many epidemics. It is an interesting illustration of the way in which apparently disparate problems are interconnected that his work owes much to the remarkable memoir of Pearson and Blakeman on random migration, a memoir inspired by the problem of mosquito distribution suggested to Prof. Pearson by Sir Ronald Ross. These researches, then, which began in the *a posteriori* study of statistics and were continued on the *a priori* assumption of a normal function being at the root of the problem, have carried us some way, but have not so far provided us with a satisfactory mathematical law of epidemics. Sir Ronald Ross, whose interest in the subject dates from so long ago as 1899, and whose latest contribution has just been published, followed a different path. Avoiding any presuppositions as to the form which the law should assume, he looked at the problem as one of *transfer*, viz., of mutual interchange between groups of affected and unaffected individuals, an interchange complicated by the subjection of each group to certain rates of natality, mortality, emigration, and immigration. Being at first specially concerned with the case of malaria, he formulated the problem in the second edition of his treatise on the prevention of malaria (pp. 651–686) in a system of difference equations, the solution of which should provide the required law. A summary of this work appeared in NATURE of October 5, 1911, under the title "Some Quantitative Studies in Epidemiology." In the paper before us,[4] these ideas have been extended and clothed in a more convenient mathematical form.

Sir Ronald Ross's method may be illustrated by summarising the simplest of his cases. If P be the whole population, x the ratio of affected to all members, v and V measures of the variation due to mortality, natality, immigration, and emigration of non-affected and affected persons respectively, and if the proportion affected in time dt be $h \cdot dt \cdot P$ where h is a constant, then we have the following system of equations:—

$$dP/dt = vP - (v - V)xP$$
$$dxP/dt = hP(1 - x) + (V - N - r)xP$$
$$dxP/dt = xdP/dt + Pdx/dt.$$

Eliminating dxP/dt and dP/dt, we have:—

$$dx/dt = h - (h + v - V + N + r)x + (v - V)x^2.$$

If, now, $v = V$, the equivariant case, the last equation can be written

$$dx/dt = K(L - x)$$

where $K = h + N + r$ and $L = h/K$.

Now put $y = L - x$ and we have $dy/y = -Kdt$.

4 "An Application of the Theory of Probabilities to the Study of *a priori* Pathometry." By Lieut.-Col. Sir Ronald Ross. Proc. Roy. Soc., A, 1916, xcii., 204.

So that if y_0 is the value of y at the beginning,

$$y = y_0 e^{-Kt} \text{ and } x = L - (L - x_0)e^{-Kt},$$

which gives the proportion of the total population affected at time t, this proportion being x_0 when $t = 0$.

Sir Ronald Ross proceeds to investigate the properties of this curve; he then takes the case of v not equal to V, which is dealt with on similar lines, and ultimately considers the curve arising in the simplest case of departure from the assumption that h is constant. The latter results are, no doubt, still somewhat remote from the conditions obtaining in practice, but they suffice to illustrate the genesis of an asymmetrical curve, and incidentally show that a form regarded by Brownlee as inconsistent with an hypothesis of constant infectivity and the termination of an epidemic by the exhaustion of susceptible persons may not be so.

The advantage of Sir Ronald Ross's method, apart from its simplicity and elegance—advantages which are, however, no mean matters—lies in its generality, so that it may be possible to include the case hypothesised by Brownlee as a particular example, precisely as Prof. Pearson's system of skew frequency curves included the normal curve as a special case. It is, of course, too early to speak with confidence. As restrictions are relaxed, the analysis will inevitably become more intricate, and, having evolved an *a priori* law, one must devise, usually by the method of moments, a way of applying the law to statistical data. This is work for the future, and all epidemiologists will await with interest the promised second part of Sir Ronald Ross's paper. No sensible man doubts the importance of such investigations as these; it is high time that epidemiology was extricated from its present humiliating position as the plaything of bacteriologists and public health officials, or as, at the best, a field for the display of antiquarian research. The work of Sir Ronald Ross, of Dr. Brownlee, and of a few others should at least elevate epidemiology to the rank of a distinct science.

M. GREENWOOD, JR.

PROF. EMILE JUNGFLEISCH.

PROF. EMILE JUNGFLEISCH, whose death occurred on April 24, at the age of seventy-seven, was born in Paris in 1839. He devoted himself to chemistry and pharmacy, and at an early age joined the Paris Chemical Society. In 1863 he was appointed dispenser to the hospital of La Pitié, and in 1869 qualified as pharmacist and member (agrégé) of the School of Pharmacy. In the same year he became assistant (préparateur) to Berthelot, who had recently been appointed to the new chair of organic chemistry of the School of Pharmacy, and on Berthelot's retirement in 1876 was made his successor. In 1890 Prof. Jungfleisch was nominated professor of chemistry of the Conservatoire des Arts et Métiers, and in 1908, again in succession to Berthelot, was appointed to the chair of chemistry

at the Collège de France. In the following year he was elected a member of the Paris Academy of Sciences, where he took the place vacated by M. Ditte.

His numerous contributions to organic chemistry include the study of the chlorine and nitro-derivatives of benzene and aniline, of which he prepared a large number; but, not content with the mere preparation of new compounds, he sought to discover the relation existing between their physical properties and constitution. He succeeded in showing that there exists a definite relation between the number of substituting atoms and their melting points, boiling points, density, and molecular weight. These results served to some extent as the basis of Kekulé's theory.

Another series of memoirs was devoted to the examination of substances exhibiting molecular asymmetry, and Jungfleisch was able to show that the different forms of tartaric acid discovered by Pasteur, when heated with water, are transformed into one another, yielding an equilibrium mixture varying with the conditions of the experiment. For these researches he was awarded, in 1872, the Jecker prize of the Academy of Sciences. Up to this time no compound possessing molecular asymmetry had been prepared artificially, and it appeared that the intervention of a vital force, as Pasteur held, was necessary to produce it. Perkin and Duppa had succeeded in converting natural succinic acid into racemic acid. Jungfleisch completed the synthesis by converting ethylene, according to the method of Maxwell Simpson, into succinic acid. He also showed that camphoric acid exists in four isomeric forms, the so-called dextro- and lævo-camphoric and *iso*-camphoric acids which he isolated. Following up a similar line of research, he succeeded in resolving inactive malic and lactic acids into their active forms.

Among his other numerous memoirs may be mentioned his work on acetylene chlorides, a new method of reduction of organic compounds by tin salts, a research on derivatives of thymol, on lævulose, which he prepared in the crystalline state, on inulin, chloral hydrate, phenylphosphoric ether, etc.

Jungfleisch collaborated with Berthelot in the study of the partition coefficient of a substance in presence of several solvents; he assisted Lecoq de Boisbaudran in isolating gallium in quantity, and applied similar methods to the preparation of indium.

One of his latest contributions to chemistry was the study of gutta-percha, which resulted in the valuable discovery that the leaves of the plant can be used as a source of the material more economically and less destructively than the stem.

Of his literary contributions to the science mention should be made of the *Journal de Pharmacie et de Chimie*, to which he contributed for twenty-two years a review of foreign researches and publications, and successive editions of his well-known "Traité de Chimie Organique."

J. B. C.

NOTES.

THE Government has appointed a Committee to recommend the steps to be taken for the relief of Sir Ernest Shackleton's Antarctic Expedition. The chairman is Admiral Sir Lewis Beaumont, G.C.B.; the other members are the hydrographer of the Navy, Major Leonard Darwin (representing the Royal Geographical Society), Sir Douglas Mawson, Dr. W. S. Bruce (who has intimate personal knowledge of the Weddell Sea area), and representatives of the Treasury, Board of Trade, and of Sir Ernest Shackleton. The Committee has already begun its meetings.

UNIVERSAL sympathy will be felt with Sir William Crookes, who has suffered the heaviest of all bereavements by the death of his wife on May 10. Lady Crookes, whose maiden name was Ellen Humphrey, was born on January 31, 1836, and was therefore in her eighty-first year. She was married to Sir William on April 10, 1856, and from the earliest times took the liveliest interest in his scientific work, helping him, amongst other things, in delicate chemical weighings and the working out of the calculations connected therewith. Her devotion to, and interest in, his work formed a great incentive, and in no small degree contributed to his successful efforts in research. Theirs was the first private house in England in which electric light was introduced, and Lady Crookes helped her husband greatly in carrying out the installation and designing the ornamental work. She was a familiar and ever-welcome figure at scientific gatherings, to which she frequently accompanied her husband, and was able to be present with him at the reception given after his election as president of the Royal Society in the year 1913. Sir William and Lady Crookes celebrated their golden wedding in 1906, when they were able to welcome a large number of their friends and acquaintances, and were also the recipients of letters and telegrams of congratulation from all parts of the world. Lady Crookes was spared to celebrate quietly with her husband last month the almost unique event of a diamond wedding, but she was then in failing health, and passed away peacefully on May 10. Several sons and a daughter survive her.

THE first meeting of the Standing Committee on Metallurgy appointed by the Advisory Council for Scientific and Industrial Research was held on Monday, May 8, at the offices of the Board of Education. The committee consists as to one-half of members nominated by the professional societies concerned, the other half being appointed direct by the Advisory Council, and it has been constituted with a view to the representation of both the scientific and the industrial sides of the industries. It consists of the following members:—Prof. J. O. Arnold, Mr. Arthur Balfour, Prof. H. C. H. Carpenter, Dr. C. H. Desch, Sir Robert Hadfield, Mr. F. W. Harbord, Mr. J. Rossiter Hoyle, Prof. Huntington, Mr. W. Murray Morrison, Sir Gerard Muntz, Bt., Mr. G. Ritchie, Dr. J. E. Stead, Mr. H. L. Sulman, and Mr. F. Tomlinson. Sir Gerard Muntz is the chairman of the full committee and of the Non-ferrous Sub-Committee, and Sir Robert Hadfield is the chairman of the Ferrous Sub-Committee. The committee was welcomed by Sir William M'Cormick, administrative chairman of the Advisory Council, and Dr. Heath, administrative secretary to the Council. Sir A. Selby-Bigge also attended, and gave an account of the genesis of the movement, and emphasised the importance which the Government attaches to the establishment of close relations between education, research, and industry. The committee then proceeded to consider various matters of fundamental importance

in regard to policy and procedure. Afterwards the two sub-committees met and formulated their lines of policy, after which they passed to the consideration of various applications for financial aid in connection with contemplated researches of industrial importance. Grants in aid have already been made by the Advisory Council towards the cost of carrying out certain metallurgical researches.

Prof. Henri Lecomte, Prof. Edmond Perrier, and Prof. Pier' Andrea Saccardo have been elected foreign members of the Linnean Society.

Dr. R. Hamlyn-Harris, director of the Queensland Museum, has been elected president of the Royal Society of Queensland for the year 1916–17.

The Bakerian Lecture of the Royal Society will be delivered on Thursday next, May 25, by Prof. C. G. Barkla, on "X-rays and the Theory of Radiation."

The twenty-first annual congress of the South-Eastern Union of Scientific Societies will be held at Tunbridge Wells on May 24–27. The retiring president is Dr. J. S. Haldane, and the president-elect the Rev. T. R. R. Stebbing.

We regret to announce the death of Prof. H. C. Jones, professor of physical chemistry in Johns Hopkins University, and author of many books and papers on inorganic and physical chemistry.

An extraordinary general meeting of the Chemical Society was held at Burlington House on May 11, to consider the question of the removal of the names of nine alien enemies from the list of honorary and foreign members of the society. No decision was reached, and the meeting was adjourned.

During recent excavations in Kent's Cavern, Torquay, the proprietor, Mr. W. F. Powe, has obtained a molar tooth of a nearly adult mammoth (*Elephas primigenius*). In the Pleistocene hyæna dens as a rule the remains only of young individuals of the mammoth occur, the smaller animals having been the more easy prey. The accumulated bones and teeth in Kent's Cavern were introduced at different times, both by hyænas and by man.

Dr. C. A. Catlin, who died recently at Providence, Rhode Island, had been chemist to the Rumford Works in that city for forty years, and was widely known as the inventor of various chemical processes and applications, many of which relate to the manufacture of phosphates for dietetic purposes. He was born at Burlington, Vermont, in 1849, and graduated in 1872 at the University of Vermont, which conferred on him in 1913 the honorary degree of Sc.D.

Dr. C. A. Davis, one of the foremost American authorities on peat, died last month in Washington at the age of sixty-four. After graduating at Bowdoin College, Maine, in 1886, he spent several years as a teacher of science in various schools and universities. Since 1907 he had been employed by the U.S. Government as a peat expert, in connection first with the Geological Survey and afterwards with the Bureau of Mines. He was editor of the Journal of the American Peat Society, and author of "Peat in Michigan" and "The Use of Peat for Fuel."

The control of the Imperial Institute will, by the new Act which has recently passed through both Houses of Parliament (see Nature, April 27, p. 184), rest with the Colonial Office. By the establishment of an Executive Council a board of management will be created, which, subject to the control of the Colonial Office, will be responsible for the operations of the institute. The relationship between the Colonial Office and the institute will thus be analogous to that between the Colonial Office and a Crown Colony. Matters of important policy will have first to receive the sanction of the Colonial Office, but, subject to this, the Executive Council will possess a general executive authority.

It has long been known that cats may be carriers of diphtheria and transmit the disease to human beings. A notable instance of this is recorded in the *National Medical Journal*. An outbreak of diphtheria occurred in an orphanage, and of seventy-one cases sixty-nine occurred on the boys' side. Sanitary defects and contamination of water and food were eliminated. Attention was then directed to the cats in the establishment, and on bacteriological examination it was found that four cats on the boys' side harboured the diphtheria bacillus, but the animals on the girls' side were free from infection. The cats were destroyed, and after this only ten more cases of diphtheria occurred, and these within a few days, showing that infection had taken place before the destruction of the cats. No further cases developed.

A note in the *Times* of May 11 states that at the monthly meeting of the Central Executive Committee of the Employers' Parliamentary Association a resolution was passed urging the necessity (1) of increasing the number of chemists trained in research work, and (2) of making special effort to enlist the co-operation of manufacturers who hitherto have been lamentably apathetic in regard to scientific industrial research and training. The resolution was brought forward in connection with the consideration of the report of the sub-committee of the Advisory Committee to the Board of Trade on Commercial Intelligence, with respect to the measures for securing after the war the position of certain branches of British industry.

The fourteenth annual session of the South African Association for the Advancement of Science will be held at Maritzburg on July 3–8 inclusive, under the presidency of Prof. L. Crawford, professor of mathematics, South African College, Cape Town. The sections, with their presidents, will be as follows:—A (Astronomy, Mathematics, Physics, Meteorology, Geodesy, Surveying, Engineering, Architecture, and Irrigation), Prof. J. Orr; B (Chemistry, Geology, Metallurgy, Mineralogy, and Geography), Prof. J. A. Wilkinson; C (Bacteriology, Botany, Zoology, Agriculture, Forestry, Physiology, Hygiene, and Sanitary Science), Mr. I. B. Pole Evans; D (Anthropology, Ethnology, Education, History, Mental Science, Philology, Political Economy, Sociology, and Statistics), Mr. M. S. Evans.

The Illuminating Engineering Society, in common with other scientific and technical institutions, has been considering the encouragement of researches of special utility at the present time, and at the annual meeting, at which Prof. Silvanus P. Thompson presided, a report on the subject was presented by the Committee on Research. A number of problems are mentioned which will receive attention, in order of urgency, at the hands of the committee. Among these are included researches on the qualities of glassware required for illuminating purposes, the study of lighting appliances (globes, shades, reflectors, etc.), and the investigation of the conditions of illumination required for various industrial processes. Attention is also directed to the need for a series of standard colours of specified tint and reflecting value, the standardisation of so-called "artificial daylight," and

the prescription of a standard method of testing the permanence of colours, all of which are of considerable interest in relation to the dyeing and colouring trades. The list includes thirty distinct sections, and it is evident that the study of all these subjects would provide work for many years to come.

Flint implements of the Neolithic type are fairly common in the Gold Coast Colony, but up to the present examples of the Palæolithic age have been wanting. In 1914 some rough quartzite stones of Palæolithic character were picked up on the coast at Accra. Mr. F. W. Migeod, in *Man* for April, announces the discovery of a rude implement in North Ashanti. It was found in a road cutting not far from the surface. The material seems to be a kind of chert, and Mr. Migeod is not disposed to attribute any great antiquity to it. He suggests that it was chipped experimentally, and was used for some temporary purpose. This supposition is confirmed by the character of the material, which is of a soft nature, and the implement would scarcely stand much rough use without losing its edge. Even if this specimen proves to be comparatively modern, it is still interesting as marking the survival of the Palæolithic type of implement in the Neolithic period.

Dr. J. H. Ashworth contributes a brief note on the hibernation of flies to the *Scottish Naturalist* for April, describing the results of an inspection of a house in Edinburgh during February last, certain rooms of which, facing south, were harbouring swarms of flies. These had evidently been hibernating behind pictures and furniture during the winter, and had been roused into activity with the return of sustained sunshine. Though still lethargic, they had crawled from their hiding-places, where many were still found, to bask in the sun streaming through the windows. In all, five species were found, mostly females; but neither house-flies nor bluebottles were met with among them. An examination of the spermathecæ revealed living spermatozoa, showing that impregnation must have taken place during the autumn, when apparently the males for the most part die.

Mr. C. Tate Regan, in his memoir on "Larval and Post-larval Fishes," published by the trustees of the British Museum as part of the official "Report on the Results of the British Antarctic (*Terra Nova*) Expedition, 1910," has accomplished a peculiarly difficult task with conspicuous success. A wide knowledge of ichthyology, and a capacity for laborious work, are apparent everywhere. But these pages owe their value not so much to the number of species which have been determined as to the insight displayed into puzzling ontogenetic changes, and the lucid interpretation he has given in regard to problems of geographical distribution, migration, and the evolution of curious structural peculiarities which disappear with larval life. Among the latter, perhaps the most extraordinary is that furnished by the post-larval stage of a Stylophthalmid, of which a figure is given. Herein the terminal portion of the gut hangs down from the body after the fashion of the rope trailed from a balloon. A special cartilaginous support is developed at the base of this trailing portion. The function of this remarkable development seems to be that of a balancer. This, however, is but one of many structural adaptations peculiar to larval life discussed by Mr. Regan in the course of his "Notes and Conclusions," wherein he summarises the results of his investigations.

A new part of the *Palaeontologia Indica* (new series, vol. vi., No. 1) is devoted to a description of additional Ordovician and Silurian fossils from the northern Shan States of Burma, by Dr. F. R. Cowper Reed, with twelve plates of beautiful drawings by Mr. T. A. Brock. Although many of the Ordovician species are new, they are clearly more closely related to the northern European than to the American forms. They are also sufficient to show that the rocks from which they were obtained may be assigned to the lower part of the Ordovician series. Among the Silurian fossils are many interesting Graptolites, which Miss G. L. Elles refers to well-known species of the European Llandovery horizon. A few Graptolites from one locality also seem to agree with those from the base of the Wenlock Shales. Various fossils prove that the Upper Silurian is represented in at least two stages corresponding with the European Wenlock and Lower Ludlow. There also seem to be some marine formations transitional to the Devonian, but more evidence is needed to determine their exact relationships.

A paper was read on April 18 before the Institution of Petroleum Technologists, by Mr. E. H. Cunningham Craig, upon the Kerogen-shales, or Scottish oil-shales, in which the author advances some novel theories upon the origin of these oil-shales. He points out that a marked characteristic of strata yielding oil by distillation is to be found in the small irregular yellow masses, which have been discovered in most of these deposits by microscopic examination. These were first held to be gelatinous algæ, and were afterwards described by Prof. E. C. Jeffery as spores of vascular cryptogams. The author has come to the conclusion that they are not vegetable fossils at all, but are small masses of inspissated petroleum. According to this view, the rocks that are now oil-shales were originally argillaceous beds sufficiently colloidal to be able to absorb the necessary quantity of inspissated petroleum from the porous petroliferous sandstones with which they were associated. Such action is only possible in anticlinal areas where the petroliferous rocks come to the surface and are subject to the influence of weathering. Thus the decrease in the yield of oil down the flanks of anticlines is successfully accounted for. The author suggests that his theory affords valuable information in selecting a site for boring for oil-shales.

We have received from Dr. N. O. Holst a reprint of his articles on the Ice age in England from the *Geological Magazine*, September–November, 1915. It is an interesting summary of the conclusions of one who has had long and varied experience of the Glacial deposits of Scandinavia and other parts of northern Europe, besides those of the British Isles, and emphasises the differences of opinion that still exist among geologists who have deeply studied the evidence of Pleistocene glaciation in this part of the world. Dr. Holst agrees with those who maintain that there was only one continuous Glacial period, and thinks there is still no proof in northern Europe of the alternation of cold and warm episodes which have been recognised and named by Penck in the Alps. He regards the high-level gravels in the valley of the Thames at Swanscombe, Grays, Ilford, Erith, and Crayford as pre-Glacial, and points out "how one warmth-loving mollusc after the other disappears from the Thames valley in proportion as the inland ice approaches." The associated flint implements at Crayford are described as oldest Mousterian. The Arctic bed at Ponder's End follows, and the well-known Thames brick-earth is truly Glacial, "belonging to the period of the melting of the inland ice." After much discussion, Dr. Holst concludes that the Ice age persisted continuously from Mousterian times, though not from their first beginning, to the close of the Magdalenian

stage, and remarks that it can be followed among British deposits from the beginning to the end. We commend his work to the notice of those who are interested in Palæolithic man and the associated mammals.

THE annual volume of "Records of the Survey in India" (vol. vii.) for 1913–14 has recently been published, and is a summary of an immense amount of useful work carried out under the supervision of the Surveyor-General of India, Sir S. G. Burrard. Apart from the details of the trigonometrical and geodetic operations, one of the most interesting chapters deals with the exploration of the north-east frontier. This work was done by Capts. Bailey and Morshead in 1913, and by the Abor exploration party in 1911–12–13. Up to that time almost the sole authority for the Abor country was Kinthup, who explored the course of the Tsan-po through the Himalayan Range in 1880–83. Kinthup, who was sold into slavery by his master, a Chinese lama, had been widely discredited, but in this report Capt. G. F. T. Oakes, in a critical discussion of his work, proves its trustworthiness.

THE report on the state of ice in the Arctic Seas for 1915 has made its appearance (*Det Danske Meteorologiske Institut, Kjobenhavn*). There are charts for April, May, June, July, and August, with full explanations of the data gathered from all available sources. The publication is printed in Danish and English in parallel columns. Most interesting are the abnormal ice conditions that prevailed in Spitsbergen waters. As early as May there were symptoms of an unusually bad season. In June the pack extended far to the westward, and there was no approach to the fjords. In July the belt of pack narrowed a little, but even in August it was lying all along the west coast. More remarkable still was the extension of this belt of pack, throughout the summer, well to the north of Prince Charles Foreland—an occurrence altogether exceptional. It is suggested by Commander Speerschneider, the author of the report, that some of the Greenland ice had drifted eastward to Spitsbergen waters, and mixed with the ice that normally sweeps round South Cape from the Barents Sea. Certainly in 1907 Greenland pack reached to 8° E. in the latitude of Ice Fjord, Spitsbergen, which is within the limits of the space covered last year by the pack under discussion. This explanation would also account for the northward extension of the ice. Off the north coast of Iceland ice conditions were bad until the end of July, which is again an abnormal state of affairs.

A GOOD instance of the high appreciation by scientific Americans of the circulars issued from time to time by the Bureau of Standards at Washington is provided by the recent issue by the Bureau of a *third* edition of the circular on magnetic testing of materials. It covers fifty pages, and is issued at 15 cents a copy by the Government Printing Office at Washington. It deals with the methods of measurement in use at the Bureau, the results obtained with typical commercial magnetic materials, and gives a great deal of general information on magnetic subjects. Induction and hysteresis data for straight bars are obtained by the Burrows form of permeameter, in which the bar under test is combined by means of two soft iron yokes with an auxiliary bar to form the magnetic circuit. Core loss determinations are made according to the specifications of the American Society for Testing Materials on strips 5 by 25 cm., cut half along, half across, the direction of rolling. They are assembled in four equal bundles, and with four corner pieces constitute the magnetic circuit. The measurements are made by means of the ballistic galvanometer in each case. A number of hysteresis curves for typical materials and a table of magnetic susceptibilities of chemical elements and compounds are given.

IN two papers published in the Journal of the Society of Chemical Industry (vol. xxxv., No. 4) Mr. G. S. Robertson discusses the question of the availability of the phosphates in basic slags and mineral phosphates. The increasing demand for phosphatic fertilisers is leading to a search for substances previously considered of little value for this purpose. The value of 2 per cent. citric acid as a solvent for testing the availability of phosphates has been challenged for minerals and fluorspar slags. On account of the low solubility of these phosphatic materials in this solvent it has often been assumed that they are not so valuable as the high-grade basic slags; indeed, Wagner introduced this test to detect the adulteration of basic slag with rock phosphate. Mr. Robertson shows that a sufficient number of extractions dissolve out quite as much phosphoric acid from the minerals as from the slags. The fineness of grinding is also an important factor in the solubility of rock phosphates. Field results at various English centres and in the United States have shown the high value of rock phosphates, and the author concludes that the citric test is worthless as a measure of the relative values of phosphatic fertilisers.

IT has usually been assumed that the wear of coins in circulation is due entirely to abrasion. In a memorandum by Sir T. K. Rose, however, contributed to the forty-fifth annual report of the Deputy-Master of the Mint, attention is directed to the effect of grease, derived from the sweat of the fingers or from other sources, in accelerating the wear of coins. The fatty acids of the grease have a corrosive action upon the metal. Copper, in particular, even if present only in small quantity alloyed with gold or silver, is converted into an oleate, stearate, or other salt. Haagen Smit, of the Utrecht Mint, found by analysis that the dirt on a bronze coin contained 36 per cent. of copper in the form of pulverulent compounds of the fatty acids. When the coin is handled the dirt is in part detached, and the coin undergoes a rapid loss of weight. Gold or silver is not readily converted into salts, but the removal of the alloying copper leaves the less easily attacked metals in a spongy form which offers little resistance to abrasion. A surface layer of pure silver at first preserves coins from chemical attack, but this layer is soon removed by mechanical wear. In new coins the rapid loss of weight which occurs is doubtless due at first to abrasion, but when the rough edges have been removed chemical action may prove to be of the first importance in the succeeding deterioration.

IN vol. xv. (part i.) of the Transactions of the English Ceramic Society the feature of most scientific interest is a series of three "Studies on Flint and Quartz," by Dr. J. W. Mellor and two collaborators. The first paper describes the effects upon quartz and flint of heating these substances at temperatures obtained in pottery ovens. It has long been known that quartz on calcination or fusion shows a notable decrease in specific gravity—a change which is presumably attributable to the conversion of the quartz molecule to a lower degree of polymerisation. Flint, it is found, undergoes similarly an alteration of specific gravity when calcined, but much more rapidly than quartz. Between grey flint and black flint there is likewise a difference in the rapidity of transformation to the form of lower density, grey flint being changed somewhat more quickly than the black variety. The practical bearing on certain ceramic operations of these differences of behaviour is pointed out. In the second

paper there is an interesting account of the formation and distribution of boulder and chalky flints; and in the third the question of substituting other forms of silica for flint in pottery manufacture is discussed. A timely article upon the national importance of fuel economy is contributed by Prof. W. A. Bone.

Several numbers of the Technologic Papers issued by the United States Bureau of Standards have recently come to hand. Each deals with a special problem of analytical chemistry which has been investigated by the departmental chemists. In No. 64 a new method is given for the determination of barium carbonate in vulcanised-rubber articles, and it is shown that the process is sufficiently accurate for use in the somewhat difficult case where sulphates of lead and barium are present simultaneously with the barium carbonate. Paper No. 65 includes a scheme for the determination of oil and resin in varnishes; tested upon samples of known composition, the process has given fairly good results. A method for the detection of resin in driers is developed in No. 66. It appears to be trustworthy except when the proportion of resin is very small. Analytical chemists who may have to deal with gums will find in paper No. 67 a useful summary of the chemistry of gum arabic. The authors of the paper find that basic lead acetate gives the most characteristic reaction for this gum, whilst for its quantitative determination they have devised an improved process, depending upon the precipitation of the gum with an alcoholic solution of copper acetate. Paper No. 69 describes a critical study of the determination of carbon in steel by direct combustion in oxygen at temperatures higher than are ordinarily employed. Although the new method gives good results, the investigators consider that the experimental difficulties place it beyond the reach of most industrial and works laboratories.

The following works are in preparation for appearance in Messrs. Longmans and Co.'s *Monographs on Biochemistry*:—"The Development and Present Condition of Biological Chemistry," Dr. F. Gowland Hopkins; "The Polysaccharides," A. R. Ling; "Colloids," W. B. Hardy; "Physical Methods used in Biological Chemistry," Dr. G. S. Walpole; "Protamines and Histones," Dr. A. Kossel; "Lecithin and Allied Substances," Dr. H. Maclean; "The Ornamental Plant Pigments," A. G. Perkin; "Chlorophyll and Hæmoglobin," H. J. Page; and "Organic Compounds of Arsenic and Antimony," Dr. G. T. Morgan.

Messrs. Macmillan and Co.'s list of forthcoming books includes the following:—"A Bibliography of British Ornithology, from the Earliest Times to the End of 1912, including Biographical Accounts of the Principal Writers and Bibliographies of their Published Works," by W. H. Mullens and H. Kirke Swann, in six parts, the first of which will be issued at the beginning of June; "Discovery, or the Spirit and Service of Science," by Prof. R. A. Gregory, illustrated (The purpose of the work is to display the nobility of scientific endeavour, the meaning and value of scientific method, and the practical service of results obtained by research); "Theoretical Chemistry," by Prof. W. Nernst, new edition, revised by H. T. Tizard; "A Manual of Practical Physics," by H. E. Hadley; "Elements of Geometry," by S. Barnard and J. M. Child, parts v. and vi.; "Second Thoughts of an Economist," by the late Prof. W. Smart, with a biographical sketch by T. Jones; "The Military Map: Elements of Modern Topography (French School of War)"; "The Statesman's Year Book, 1916," edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein.

OUR ASTRONOMICAL COLUMN.

Stereoscopic Spectroheliograms.—A remarkable pair of photographs of hydrogen (H_{α}) flocculi, showing a stereoscopic effect, have been forwarded to us by Prof. Hale. They were taken with a new grating spectroheliograph, used in conjunction with the 60-ft. tower telescope at Mt. Wilson, and exhibit the flocculi surrounding a large spot-group near the sun's west limb on August 7, 1915. The time interval between the two exposures was seven minutes, giving a separation of the two images due to the sun's rotation somewhat greater than Helmholtz's estimate of 1′ for the minimum angular separation of two objects just sufficing for stereoscopic vision. The photographs show the structure of the flocculi in a way which at once recalls Langley's well-known representation of the minute details of the photosphere about a spot; and a long, dark flocculus, which afterwards appeared as a prominence on the west limb, is distinctly seen in relief. Photographs of this kind must necessarily be affected by changes in the actual details in the interval between the exposures, and by distortion arising from drift of the solar image, or from irregular motion of the spectroheliograph, during exposure; but Prof. Hale believes that with due precautions the stereograms will assist in clearing up some of the questions referring to relative levels. A check on the reality of the stereoscopic relief has been obtained by taking photographs of a globe having a roughened surface, turned through angles corresponding with the intervals between the solar photographs.

A Variation in the Solar Rotation.—In the programme of spectroscopic work at the Ottawa Observatory a considerable place is devoted to the investigation of the solar rotation. In the most recent publication Mr. H. H. Plaskett gives an account of a special inquiry regarding its variability in time (*Astrophysical Journal*, vol. xliii., No. 2). In order to regularise the personal equation and avoid bias all measurement was postponed until the desired series of spectra had been secured; the plates were then mixed, divided into two bundles, and measured with two quite different types of machines. The displacements of eight lines, including three of telluric origin, to serve as a check on possible instrumental displacements, were measured. Three possible modes of variation were looked for: (1) diurnal; (2) short period; and (3) secular changes. The evidence indicates that daily variations, if existent, do not reach 0·1 km.; variations of the second and third types are revealed in a cyclic change of 0·15 km. with a period of about a month, and a diminution of rotational velocity amounting to 0·04 km. since 1913. The research is a typical example of the thoroughness already traditional at Ottawa.

The Great Meridian Circle of the Paris Observatory.—The annual reports of the Paris Observatory for the last two years contain some interesting facts concerning the working of this instrument. After accidental damages the indications of the repaired level were discordant, so that throughout the past twelve months the determinations of inclination of the axis have been entirely made by nadir observations, employing the suspended mercury bath devised by M. Hamy. Another modification of procedure concerns the collimation error. It was found that when the usual daily determinations were employed the resulting clock rates showed variations greater than could be expected. Consequently use is now made of a weighted mean value of the collimation error determined by observations of circumpolar stars at upper and lower culminations.

THE "SUMMER TIME" BILL.

THE main provisions of the "Summer Time" Bill, which was introduced in the House of Commons on May 9 by the Home Secretary, Mr. Herbert Samuel, and was read a second time in the House of Lords on May 16, are as follows:—

(1) During a prescribed period the local time in Great Britain is to be one hour in advance of Greenwich mean time.

(2) The prescribed period this year is from two o'clock in the morning Greenwich mean time on Sunday, the twenty-first day of May, until two o'clock in the morning Greenwich mean time on Sunday, the first day of October, and during the continuance of the present war the Act can be declared by Order in Council to be in force for any prescribed period.

(3) During the prescribed period any expression of time in any Act of Parliament, Order in Council, order, regulation, rule, or by-law, or in any deed, time-table, notice, advertisement, or other document, is to mean "Summer Time."

(4) The Act is to apply to Ireland as to Great Britain, with the substitution, however, of references to Dublin mean time for references to Greenwich mean time.

(5) Greenwich mean time is to be maintained as hitherto, for purposes of astronomy or navigation.

No particular time is prescribed for meteorologists, who are left to decide for themselves whether to record their observations at the same hour G.M.T. throughout the year, or to adopt the Summer Time for five months and G.M.T. for the remainder. A like difficulty arises with self-registering meteorological instruments, which are used to record continuously day and night. Either the instruments are to be an hour wrong in the summer, or meteorologists are to use a time-system different from that of the general public. For example, the five thousand voluntary observers connected with the British Rainfall Organisation record their readings at 9 a.m., which is to be 10 a.m. Summer Time. Dr. H. R. Mill, director of the Organisation, has had to announce to his observers that the readings should be taken, if possible, at 9 a.m. G.M.T., as hitherto, or a note should be made on each page of the observation book if the readings are taken at 9 a.m. Summer Time. Anyone who is concerned with the preservation of records for long series of years must contemplate with blank dismay the dual system about to be introduced.

Lighting-up times, as was stated in last week's NATURE, depend upon local times of sunset, and are therefore based upon Greenwich mean time, with differences for latitude and longitude. The *Law Journal* points out that since sunrise and sunset always mean in law the exact moment at which the sun rises or sets at any particular place, the obligation to light up vehicles an hour after sunset—an interval which is reduced to half an hour during the war—is not affected by the Summer Time Bill. The law will thus maintain local time for many of the statutes in which time is mentioned, and this, for nearly all places in Great Britain and Ireland, will be later than Greenwich time, not an hour earlier, as the Summer Time Bill prescribes. As the tides, sunrise and sunset, lunar phases, and like occurrences belong to navigation and astronomy, they will continue to be tabulated in advance in Greenwich time; but all public clocks are to show mid-European time.

The economic and social advantages claimed for this introduction of confusion into an orderly system of time-reckoning remain to be seen; but whatever they are there can be no question that the scheme of a fluctuating time-standard has no natural basis. It is the duty of a scientific journal to point out the objections to the scheme, even though it stands alone, and, in the opinion of the public, may represent what is contemptuously termed scientific theory as something apart from the practical needs of life. The difficulties are not appreciated by our legislators, and few writers in the public Press have shown any intelligent understanding of them, while scientific interests have been completely disregarded. The only satisfaction to be derived from this childish method of promoting the increased use of daylight is that the measure is limited to the period of the war.

PURIFICATION OF COAL-GAS.

PROF. FRANK CLOWES read a paper before the Society of Chemical Industry on May 1 dealing with the past and present of the sulphur impurity in coal-gas. He recalled that the higher temperature carbonisation arising from the displacement of iron by fireclay retorts had resulted in an increased amount of sulphur coming into the gas, not only in the form of hydrogen sulphide, but more noticeably as sulphur compounds of an organic nature. Purification by iron oxide is sufficient to remove sulphuretted hydrogen, but the removal of these organic compounds is much more difficult. "Sulphided lime," prepared by passing coal-gas containing hydrogen sulphide, but free from carbon dioxide, over freshly slaked lime, was in common use for the purpose, but its action was so uncertain that a Board of Trade Committee which inquired into the subject came to the conclusion that any statutory requirement that the sulphur impurities should be removed to such an extent as to demand the use of lime ought to be discontinued. The detrimental physiological effect and very slight, or non-existent, disinfectant value of the sulphurous products of combustion of coal-gas were, however, plainly indicated by Dr. Haldane, and experimental results were also brought forward which proved that these sulphurous products caused leather to rot and ultimately to crumble, and that some fabrics were similarly affected.

Dr. C. Carpenter and his collaborators have advanced matters by working out on the large scale a practical method of removing carbon bisulphide by passing the gas at a temperature of about 450° C.[1] (the author gives the temperature 450° F., presumably a misprint) over fireclay surfaces impregnated with reduced nickel. The hydrogen sulphide formed is removed by subsequent exposure of the coal-gas to iron oxide, and the carbon deposited on the fireclay-nickel surface is burned off; the sulphur of the coal-gas is so reduced to about 8 grains per 100 cubic feet.

A similar process is in the hands of an investigator in France, and it appears that the immediate possibility of distributing a much purer gas supply is presented to the gas industry.

PREHISTORIC ART.

A MELANCHOLY interest attaches to a paper entitled "Nouvelles découvertes à Laugerie Basse: Rabots, os utilisés, œuvres d'art," by Capt. Bourlon, published in the last issue of *L'Anthropologie* (vol. xvii., Nos. 1–2, for January-April), because the gallant officer was killed at the opening of the war. The paper has now been edited by M. l'Abbé Breuil. These new discoveries in this famous cave are of remarkable interest, including a fine collection of flint implements, among which the rabots, or scrapers, are of exceptional interest. We have also fine examples of work in bone, including many heads of animals engraved on this material. The engravings on stone, besides those of the normal type, display some curious variants. Of these the most remarkable are a splen-

[1] Trans. Inst. Gas Eng., 1914, p. 213.

did picture of a red bear, stags, bison, and a figure of a bird with a long, slightly curved beak, with a protuberance on the throat, which may make it possible to identify the species.

This type of prehistoric art is also illustrated in a novel way in a paper in the same issue of *L'Anthropologie* by M. E. F. Gautier, entitled "Nouvelles Stations de Gravures rupestres Nord-Africaines," which describes a series of rock sculpturings at a place to the north of Figuig, on the Algerian-Moroccan frontier. These include elephants, lions, an animal possibly a giraffe, and ostriches. The author remarks that eminent geologists, on the analogy of the prehistoric drawings in the French caves, are disposed to assign the North African specimens to the Quaternian age. But he warns us that the collection of examples was made in the course of a rapid tour, and that it is still far from complete. Much further exploration is required before any definite conclusion regarding this type of prehistoric art and the ethnology of the artists can be formulated.

SCIENCE AND CLASSICS IN MODERN EDUCATION.[1]

THE resolution I have the honour to move seems to need but few words to commend it to a meeting of scientific men. But we have to bear in mind that it is not scientific men that have to be convinced, and it becomes necessary therefore to state clearly what it is that we desire, and why we desire it.

I propose to begin, however, by stating what it is that we do not desire, my reasons for so doing being that our aims have been grossly misrepresented in the past, as they will no doubt continue to be misrepresented in the future. Thus, in expressing the opinion that science ought to oust the study of Greek and Latin from the prominent position which these subjects hold in the educational course of our schools, we have been accused of wishing to kill all learning but our own. The accusation is baseless. We have never expressed any such desire. No one of us would be so foolish as to wish that the classics should not continue to be a serious branch of study. We do not contest that an intimate knowledge of Greek and Latin may help towards the attainment of literary and oratorical style, or that it may even add to the amenities of conversational intercourse. We admire—some of us from a long distance—the favoured few who are possessed of those advantages. But it is the many we have to consider in the matter of general education, and we ask ourselves—looking over the circle of our acquaintances at those who have had the inestimable privilege of having Greek and Latin swished into them from their earliest years—whether in the great majority there is any sign that there was ever much penetration beyond the skin, and whether the educational benefits which the—for the most part long-forgotten—acquisition of these languages has bestowed are really worth the enormous amount of time and trouble expended upon them. This is, of course, an entirely different question from what I may perhaps be permitted even by our opponents to call the *scientific* study of classical languages and literature, which is on an altogether different footing, and cannot be promoted by forcing Greek and Latin on every schoolboy, whether he has aptitude for it or not, to the exclusion of subjects the knowledge of which would at least be of some benefit to him in after life.

We must all admit that there is not time for any adequate study of both the classics and the natural sciences in the general educational curriculum; surely, therefore, it is scarcely fitting to omit subjects which in any conceivable circumstance of life may prove of some value in order to retain those which can only be valuable in professions which demand a certain standard of literary attainment. But I am not prepared to concede that knowledge of the classics is necessary for the production of the best English. I refer to this point particularly because the claim has been recently made by one of the champions of the present system of education that without such knowledge we are unable adequately to express our ideas in our own language. The absurdity of this contention is obvious at a time when we are commemorating the tercentenary of the author whose immortal works were written under all the disadvantages of the possession of "small Latin and less Greek." Perhaps it is unfair to bring in evidence so transcendant a genius as Shakespeare; he, one feels, even with a complete classical education, would still have succeeded in bewitching the world with his wonderful imaginings and in inspiring his characters with the attributes and sentiments which his puny fellow-mortals have marvelled at for three hundred years, and will doubtless continue to admire as long as our world continues. Nevertheless, if Shakespeare had gone through a course of Eton and Oxford the language those sentiments are clothed in would certainly have been different, and I imagine that not even the most pro-classical of our opponents but is thankful that he escaped.

I am content, however, to leave Shakespeare on his pinnacle—unattained and unattainable—and to recall the name of one John Bunyan. Has anyone amongst the polished eighteenth-century essayists written in a clearer style than this Bedfordshire tinker's son, whose literary studies were mainly confined to the Bible? Or, to take an instance from our own times, was there ever a finer political speaker than John Bright, "the great tribune," whose utterances, couched in simple, vigorous English, were wont to pass straight from his own heart to that of his audience? And is there not another writer and speaker of whom we are many of us proud to have been the disciples, and whose spirit we may well imagine to be with us this afternoon, who, without the advantage of a classical upbringing, was pre-eminent amongst nineteenth-century authors for his faultless diction and for the direct and terse enunciation of his ideas; needless to say, I refer to Thomas Henry Huxley.

We have further been accused of desiring, in our enthusiasm for science, to oust such subjects as modern history, and geography, and the study of the English language and literature from the educational curriculum. No accusation can be more unfair. We recognise that these subjects must for us form a fundamental part of all education. They *have* been ousted from the present scheme because their immediate relation to the classical languages and literature was remote, and the amount of knowledge of Greek and Latin which has been required in competitive examinations has needed all the time at the schoolmaster's disposal. We believe, however, that there will, if the greater part of that time can be recovered, be opportunity afforded for the acquisition of such knowledge of the subjects in question as will help to fit our boys and girls to become worthy citizens of this great island-empire.

But in order that there shall be a reasonable chance of our being able to maintain our place in the world it is above all necessary that we should move with the times. We are a long way from the eighteenth century—when a sound education in classics was recognised as the be-all and end-all of a boy's upbring-

[1] Remarks made by Sir Edward Schäfer, F.R.S., in proposing the first resolution at the meeting on the Neglect of Science held at Burlington House on May 3 (see NATURE, May 11, p. 230).

ing. Science was then in its infancy. Throughout the nineteenth century it was advancing by leaps and bounds. In this twentieth century we meet it at every turn; there is no getting out of its path. That this is truly the age of science we have no lack of evidence in the present war, but the statement is no less true and is even more important in its application to the occupations of peace. And if we wish to live up to our age we must do what in us lies to promote the progress of science. The mere diffusion of scientific knowledge throughout the community will be directly beneficial; but, besides this, certain important consequences must follow such diffusion. Not the least of these is the capability of appreciating the fact that it is necessary for our prosperity—nay, for the continuance of our very existence—that in every possible way knowledge of science should be advanced. Let us make no mistake on this point. The nation which recognises this necessity will succeed, the nation which refuses to recognise it will fail.

We make no claim to have eminent representatives of science in the Cabinet. We believe in the cobbler sticking to his last. The qualities for which politicians are chosen are rarely found in men who devote their lives to the pursuit of science. But we think that even Cabinet Ministers should know something about the world they live in and the bodies they inhabit. Surprise has been expressed at the singular ignorance displayed by distinguished statesmen of simple facts in chemistry and physiology, familiar to the most junior student. This ought not, however, to be surprising. What chance have they had to acquire any knowledge on these subjects? Usually none at all. We meet with the same kind of ignorance in such a generally well-informed quarter as the editorial column of a newspaper; nor can this be otherwise considering that the journalist has as a rule the same kind of education as the politician—an education in which science has occupied no part. Neither is able to distinguish between a real and *soi-disant* authority on a scientific subject, and for this reason we frequently find the utterances of a quack quoted as of equal value with those of a master in science. And if men like these—men who have had the highest educational advantages which our schools and universities can afford—are so deficient in knowledge of things around them: things which really matter, and which affect the well-being and prosperity of the whole community: what can be expected from the ruck of their fellow-graduates who have taken—or perhaps been excused—the ordinary degree at our universities, and who have acquired in that laborious process little but a smattering of certain ancient languages, which they very soon contrive to get rid of? Or, if anything remains, it is of no possible use to them in the practical avocations—agricultural, commercial, or manufacturing—which will occupy so much of their subsequent attention. Whereas, had the time which most of them have thus wasted in classical studies been devoted to the acquisition of a basal knowledge of the physical and biological sciences, it may confidently be affirmed that the living interest which these subjects afford would lead to a desire for the extension of such knowledge, and that its possession could not but prove of definite advantage in their future career.

It is, however, constantly alleged by our pro-classical friends that whatever may be said for the teaching of science on utilitarian grounds the study of the classics has shown itself by long experience to have such inestimable advantages as an educational asset in the formation of character that it is not possible for any other branch of knowledge to take its place in the curricula of our schools and universities. This allegation must, in the absence of specific proofs, be met by us with the most absolute denial. The evidence we possess is indeed altogether on the opposite side. Of all the public services the one which is pre-eminent for the high character and efficiency of its officers is by universal consent the Royal Navy. And this is also distinguished from the rest by the fact that from the very first the training given is mainly a training in scientific methods, whilst the very subjects which are alleged by so many instructors of youth to be essential to a scheme of general education are rigorously excluded. We have here, in fact, an experiment in education which has been conducted on a large enough scale for us to draw definite conclusions from it, and I venture to say, without fear of contradiction, that the results are altogether in favour of the proposal to substitute science for classics in the schools and universities of this country.

Lastly, let us look for a moment at the sentimental side. More than one recent writer has argued as a proof of the efficiency of the existing system that if it is productive of no other benefit, the experience of the present war has shown that it has at least taught our boys how to die. The obvious answer to this appeal to sentiment is that the lesson has been just as well learned by those who have not passed under the classical yoke. Men of all classes of the community have done their duty equally bravely and unflinchingly. The courage and self-sacrifice which have been so abundantly displayed in our fighting Services and their auxiliaries cannot therefore be looked upon as the result of this or that system of education, but must be regarded as part of the common heritage of our race, of which we may all be justly proud. There is, besides, one thing which is of equal, or even greater importance than the knowledge of how to die, and that is the knowledge of how to live. Nevertheless, we are content to be ignorant of everything that pertains to our bodily life; ignorant of the functions of our organs, of their maintenance in health, of the evils which follow the abuse of those functions, of the relation of our bodies to their environment, of everything which tends to develop a healthy mind in a healthy body. True, many of us muddle through somehow in spite of this ignorance, but far too many suffer severely on account of it, and one of the benefits which will accrue from a diffused knowledge of science will be apparent in an enhanced interest in all questions affecting the health of the individual and the community. An educational curriculum which offers nothing beyond a little Greek and Latin must, by its very nature, produce an unfertile soil, permanently incapable of encouraging the growth of such knowledge as is of real value in the battle of life.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An exhibition of 50*l.* a year, tenable for two years, is offered each year by the governing body of Emmanuel College to a research student commencing residence at Cambridge as a member of Emmanuel College in October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than September 24.

London.—The report of the Vice-Chancellor on the work of the University during the year 1915–16 gives many interesting particulars as to the war work accomplished by the University. The total number of commissions granted to cadets and ex-cadets of the University Contingent of the Officers Training Corps since the outbreak of the war is 2031, and of com-

missions granted to other graduates and students is 273. Honours and distinctions conferred include one Companionship of the Bath, one Victoria Cross, thirty Military Crosses, and seventy-eight Mentions in Despatches. Eighty-nine members of the contingent have fallen in the war. Returns received already from schools and institutions of the University show that upwards of 600 members of the staffs, and more than 6000 of their present and former students, have gone to the war. During the year the number of these who have given their lives has been 226. A large number of professors, demonstrators, and others, both teachers and students, are engaged in assisting the national authorities as chemists, physicists, engineers, and otherwise.

OXFORD.—The statute providing that original experimental investigation shall be a necessary condition for obtaining a class in the honour school of chemistry passed Convocation on May 16 without a division. This marks an important new departure in the regulation of chemical work at Oxford. It is hoped in many quarters that the principle thus established may be widely extended, so as to affect other scientific subjects besides chemistry.

The Halley Lecture for 1916 will be delivered in the Hall of Queen's College at 8.30 p.m. on Saturday, May 20, by Dr. G. W. Walker, late fellow of Trinity College, Cambridge. His subject is "The Measurement of Earthquakes."

SHEFFIELD.—Under the will of the late Mr. W. Edgar Allen, for many years chairman of Messrs. Edgar Allen and Company, Ltd., Imperial Steel Works, Sheffield, the sum of 32,000*l*. has just been paid to the University. Mr. Edgar Allen left estate of the gross value of 271,068*l*., of which the net personalty was sworn at 251,792*l*. Among the numerous legacies for Sheffield institutions was the whole of his books for the University library, of which Mr. Allen was the donor. He also appointed the University one of the residuary legatees. Two-fifths of the residue of the property was to go to the University of Sheffield, one-fifth to Dr. Barnardo's Homes for general purposes, one-fifth to the Church Army for general purposes, and one-fifth to the Salvation Army for general purposes.

The 32,000*l*. mentioned is part of the residue of the estate, though when the distribution is completed the University will most likely receive further substantial proof of the late Mr. Allen's thoughtful generosity. The sum of 5000*l*. is intended by the will for the Applied Science Department of the University, and the balance is to go to University scholarships, half of the sum to be reserved for the sons of workingmen.

Sir Joseph Jonas, chairman of the Applied Science Committee, who has been a generous supporter of the University from the time of its inception, was a close friend of the late Mr. Allen, and he agreed to give 5000*l*. to the Applied Science Department, and this, with the sum left by Mr. Allen—10,000*l*. in all—will be devoted to the provision of materials-testing laboratories for the department, to be known respectively as "The Edgar Allen Physical Testing Laboratory" and "The Jonas Mechanical Testing Laboratory." In regard to any further amount which may still be received under Mr. Allen's will, this sum will be set aside for the provision of further scholarships.

SUMMER evening classes began at the Manchester Municipal School of Technology on May 15. From the prospectus, a copy of which has been received, we find that classes at low fees have been arranged in numerous branches of mechanical, electrical, municipal, and sanitary engineering, chemical technology, mining, the textile industries, and in some departments of pure science. That Manchester students are willing to devote themselves to evening study during the summer months is a satisfactory indication of their earnest intention to qualify themselves to take a worthy part in the international industrial competition of the future.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 11.—Sir J. J. Thomson, president, in the chair.—Major P. A. **Macmahon**: Seventh memoir on the partition of numbers. A detailed study of the enumeration of the partitions of multipartite numbers. Whereas a unipartite number m enumerates objects of the same species, a multipartite number $m_1, m_2, m_3 \ldots$ may be regarded as numbering objects which involve similarities. The problem is the partition of a multipartite, or dividing up into sets of objects a given assemblage of objects, the division being subject to various governing conditions. The author showed long ago that the solution is implicitly contained in the algebra of symmetric functions. The difficulty has been in the evaluation of numerical coefficients which arise in the development of the symmetric function which presents itself as the solution for a particularly specified problem of partition. The discovery of the paper is principally that there exists a set of symmetric functions, $Q_1, Q_2, \ldots Q_i \ldots$ such that the effect of any one of the operations upon the product $Q_1^{k_1}, Q_2^{k_2}, \ldots Q_i^{k_i} \ldots$ is merely to multiply it by an easily ascertainable integer, combined with the circumstance that the symmetric function operand can be expanded in terms of such products. The result is that laws are obtained. It is established that under any given conditions enumeration in regard to a unipartite number m_s is given by the expression $\lambda a_s + \mu b_s + \nu c_s \ldots$ wherein $\lambda, \mu, \nu, \ldots$ are constants. Then the enumeration in regard to a multipartite number $m_1, m_2, \ldots m_s$ is given by

$$\lambda a_1 a_2 \ldots a_s + \mu b_1 b_2 \ldots b_s + \nu c_1 c_2 \ldots c_s + \ldots\ldots$$

It is therefore only necessary to obtain the unipartite solution in the form above given, when the multipartite solution at once follows. The set of functions Q can be modified to meet any specified conditions of partition. The complete solution of the problem of multipartite partition has thus been reached.—Lord **Rayleigh**: Legendre's function $P_n(\theta)$ when n is great and θ has any value. As is well known, an approximate formula for Legendre's function $P_n(\theta)$, when n is very large, was given by Laplace. The subject has been treated with great generality by Hobson, who has developed the complete series proceeding by descending powers of n, not only for P_n, but also for the "associated functions." The generality arrived at by Hobson requires the use of advanced mathematical methods. A simpler derivation, sufficient for practical purposes and more within the reach of physicists with a smaller mathematical equipment, may be useful. It had, indeed, been worked out independently. The series, of which Laplace's expression constitutes the first term, is arithmetically useful only when $n\theta$ is at least moderately large. On the other hand, when θ is small, P_n tends to identify itself with the Bessel's function, $J_0(n\theta)$, as was first remarked by Mehler. A further development of this approximation is here proposed. Finally, a comparison of the results of the two methods of approximation with the numbers calculated by A. Lodge for $n=20$ is exhibited.—Prof. A. **Dendy**: The occurrence of gelatinous spicules and their mode of origin in a new genus of siliceous sponges.

Collosclerophora arenacea, n. gen., n. sp., a sand-sponge from Australia, contains an entirely new type of spicule, for which the name *collosclere* is proposed, and similar spicules are met with in another species from the Indian Ocean. The collosclere differs from all spicules previously known in the fact that it consists of a gelatinous material, contracting on the addition of alcohol and swelling up again on the addition of water. Evidence is brought forward to show that these spicules are composed of colloidal silica containing a higher percentage of water than the hydrated silica or opal of which ordinary siliceous spicules are composed. The collosclercs lie in vesicles in the mesoglœa, but these vesicles do not represent the mother-cells or scleroblasts by which they are secreted. On the contrary, the collosclere is an extra-cellular product, and first appears as a knob on the outer surface of the cell-membrane of a large spherical scleroblast. The colloscleres may be homologous with isochelæ, but the supposed intra-cellular origin of the chelate and other microscleres must be re-investigated before this point can be established.—E. S. **Goodrich**: The classification of the Reptilia. The group Reptilia represents not a true monophyletic class, like the class Mammalia and the class Aves, but rather an assemblage or grade of Amniotes retaining a more primitive general structure. The Reptilia thus include a basal Protosaurian group of amphibian-like forms leading to a central point, from which diverge two main branches—the Sauropsidan branch leading to the birds, and the Theropsidan branch leading to the mammals. The modern classification of the reptiles, based chiefly on the structure of the skull, is in a very uncertain state. There is a great difference of opinion as to the relationship of the various orders. Certain specialisations in the skeleton of the hind foot and in the structure of the heart and great vessels (in living forms) are of great importance in classification, and deserve more weight than has hitherto been attributed to them. The development of a hook-shaped fifth metatarsal and of a metatarsal articulation, and the subdivision of the aortic trunk so as to form two systematic arches crossing at their base in such a way as to become separated by the interventricular septum, clearly distinguish the Sauropsidan from the Theropsidan line of evolution. The possession of these characters shows that all living Reptilia belong to the Sauropsidan group, while the structure of the foot enables us to determine the affinities of many incompletely known fossil genera, and to conclude that only certain extinct orders can belong to the Theropsidan branch.—Dr. R. **McCarrison**: The experimental production of congenital goitre.

Mathematical Society, May 11.—Sir Joseph Larmor, president, in the chair.—Prof. H. M. **Macdonald**: A note on electrostatic problems.—G. B. **Jeffery**: The relations between spherical, cylindrical, and spheroidal harmonics.—E. K. **Wakeford**: The double six.—J. G. **Leathem**: Theorems on conformal transformation.—G. H. **Hardy** and S. **Ramanujan**: A problem in the analytic theory of numbers.

EDINBURGH.

Royal Society, May 1.—Dr. J. Horne, president, in the chair.—Dr. H. **Rainy** and Miss C. M. **Hawick**: A clinical method for the estimation of sugars in the blood. The method was a modification of the method described by Bang, and had advantages over other methods on account of the small quantity of blood which was required and the comparatively short time in which the tests and measurements were made. The method was also equally applicable to the estimation of sugar in the urine. Experiments showed that the blood sugar rose very rapidly to its maximum, while in the kidneys the maximum was not reached until an hour later.—Dr. A. E. **Cameron**: The insect association of a local environmental complex in the district of Holmes Chapel, Cheshire. The districts with which the study is concerned were two fields, Glover's Meadow and the alluvial pasture situated in the farm land of the Holmes Chapel Agricultural College. In these fields the soils were respectively a reddish clay loam and a dark-coloured loam. The plant environment and its relation to the insects were fully considered; also the physical factors of the environment, such as water content, humidity, light, temperature, precipitation, wind, soil, exposure, slope, and the like. The index of an insect's habitat is where it breeds, and it is important to recognise endemic forms which are proper to an association and polydemic forms which are invaders. Detailed accounts were given of the various orders of insects found, such as Diptera, Coleoptera, Neuroptera, Apterygota, Hymenoptera, etc.; and the facts were brought together in a series of tables, showing the months of occurrence of the different species, their habits, and the plants with which they were associated. Another point of interest was the relation of the soil-inhabiting insects to the food habits of ground-feeding birds.

PARIS.

Academy of Sciences, May 1.—M. Camille Jordan in the chair.—G. **Lemoine**: The catalysis of hydrogen peroxide in heterogeneous medium. Second part: experiments with platinum. Experiments were carried out with distilled hydrogen peroxide containing 8·6 per cent. of the pure peroxide, in contact with platinum black and platinum sponge, both at a constant temperature. The results are given in graphical form. The velocity of decomposition increases with the weight of the catalyser and with the state of division of the platinum. Comparison of platinum black with the sponge, in approximately the same state of division, shows that the platinum black exerts a special catalytic action, much more energetic, and due to a distinct cause.—H. **Le Chatelier**: Science in its relations with the economic development of a country.—A. **Righi**: Experiments relating to the influence of the magnetic field on the charge of a conductor in rarefied air. Details of an experiment which, in the opinion of the author, renders necessary the hypothesis of magneto-ionisation, the action of the magnetic field favouring ionisation by shock.—E. **Kogbetliantz**: The Sturm-Liouville series simply capable of summation.—G. **Vacca**: The *Harmonicon coeleste* of François Viète.—G. **Bigourdan**: Remarks on the preceding note.—A. **Bilimovitch**: The trajectories of a non-holonomial system.—T. **Peczalski**: The determination of the law of integral radiation of a solid from the light yield.—E. **Moles**: The absolute density of gaseous hydrobromic acid. The gas was prepared by two independent methods, liquefied, and purified by fractional distillation. The figures obtained for a litre of the gas under normal conditions varied between 3·6439 and 3·6447 grams, with a mean of 3·6444 grams.—L. **Reutter**: The analysis of two resinous masses used by the Incas of South America for embalming their dead. These consisted mainly of Peru and Tolu balsams, with some volatile essences containing menthol.—P. de **Sousa**: Contribution to the petrographical study of the south-west of Angola.—V. **Raymond** and J. **Parisot**: The etiology, prophylaxy, and therapeutics of the affection called trench feet. This affection appears to be due to a pathological fungus, *Scopulariopsis Koningii*.

Washington, D.C.

National Academy of Sciences (Proceedings No. 4, vol. ii., April 15).—By the committee of the National Academy of Sciences appointed at the request of the President of the United States: Preliminary report upon the possibility of controlling the land slides adjacent to the Panama Canal.—H. **Shapley**: Discovery of eight variable stellar spectra. It appears safe to infer that all Cepheids (including the cluster-type), besides being variable in light and in velocity, vary periodically in spectral class.—G. M. **Green**: The linear dependence of functions of several variables, and certain completely integrable systems of partial differential equations. The theory of linear dependence is generalised to the case of n functions of several independent variables, and is applied to the study of an important class of systems of partial differential equations.—B. **Boss**: Systematic motion among stars of the helium type. There appears to be a strong tendency for the helium stars to move in their own plane, which should therefore be preserved, at least until the next step in the star's evolution. But there are likewise strong tendencies on the part of helium type stars to depart from the plane, so that the tendency for the stars to spread in every direction has its birth in the helium stage of evolution.—W. D. **Harkins**: The abundance of the elements in relation to the hydrogen-helium structure of the atoms. A spiral form of the periodic table is given. The elements are found to arrange themselves in three cycles containing respectively 4^2, 6^2, 8^2 elements, the last being incomplete. The even-numbered, or helium-system, elements are very much more abundant in nature than those of the odd-numbered, or lithium, system.—C. **Wissler**: The genetic relations of certain forms in American aboriginal art. The investigation reveals several good examples of the genesis of specific decorative designs growing out of attempts to embellish surfaces of fixed contour and to conceal unsightly lines.—C. E. **St. John**: The situation in regard to Rowland's preliminary table of solar spectrum wave-lengths. The general transformation from the system of Rowland wave-lengths to the international wave-lengths is a matter of the greatest difficulty, even though the relative wave-lengths in each system be free from error; and statistical comparison between different systems is a procedure fraught with the possibilities of introducing residuals that may be quite misleading.—E. P. **Hubble**: Changes in the form of the nebula N.G.C. 2261. The nebula appears to be turning about its own axis after the manner of a top, and there is some indication of a helical motion towards the nucleus. The observed shifts seem to be rather of mass than illumination, and are independent of the variability of the nucleus.—Ruth B. **Howland**: The effect of removal of the pronephros of the amphibian embryo. Removal of both pronephroi leads to œdema and death, though the presence of one is sufficient to keep the embryo healthy, bringing about an increase in size in the remaining organ.—R. **Ruedemann**: The presence of a median eye in trilobites. The question of the presence or absence in trilobites of the median eye is of considerable phylogenetic importance. The median eye appears in the majority of cases as a single tubercle, and there is evidence for the visual function of the tubercle.—W. J. V. **Osterhout**: The nature of mechanical stimulation. In this conception of mechanical stimulation the essential things are:—(1) Substances which are more or less completely prevented from reacting by semi-permeable surfaces; (2) a deformation of the protoplasm sufficient to produce in some of these surfaces a rupture which is not at once repaired; (3) a resulting reaction which produces the characteristic response to the stimulus.—R. E. **Clausen** and T. H. **Goodspeed**: Hereditary reaction-system relations: an extension of Mendelian concepts. The mechanical Mendelistic theory of Morgan is applied in the study of Nicotiana, and it is suggested that by the application of such conceptions to Œnothera the occurrence of mutants and their subsequent behaviour admit of logical interpretation.—A. B. **Coble**: Point sets and allied Cremona groups (part ii.). Theorems such as the following:—A pencil of plane cubic curves can be transformed by ternary Cremona transformation into only 960 projectively distinct pencils of cubics—are proved.—M. B. **Porter**: A theorem of Lucas. A simple proof is given for Lucas's theorem that the zeros of any polynomial $F'(z)$ lie inside any closed convex contour inside of which the zeros of $F(z)$ are, and the theorem is extended to give information concerning the distribution of zeros of the derivative of certain relational or transcendental functions.—E. J. **Wilczynski**: Interpretation of the simplest integral invariant of projective geometry.—W. E. **Castle**: Size inheritance in guinea-pig crosses. Preliminary studies published in 1909 showed that size and weight in rabbits do not follow the Mendelian rules of dominance and segregation as unit-characters. A large amount of material being now available upon guinea-pigs, attention is invited to the nature of the growth curves observed for the races crossed and to non-genetic, as well as genetic, factors affecting size. From these crosses there is no evidence showing either the existence of numerous multiple Mendelian factors, or of a few Mendelian factors, or of a single Mendelian factor affecting size.

BOOKS RECEIVED.

Subtropical Vegetable-Gardening. By P. H. Rolfs. Pp. xviii+309. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

The Mechanical Engineers' Pocket-Book. By W. Kent. 9th edition, revised, with the assistance of R. T. Kent. Pp. xliv+1526. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s*. net.

Theory and Applications of Finite Groups. By Profs. G. A. Miller, H. F. Blickfeldt, and L. E. Dickson. Pp. xvii+390. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. net.

Modes of Research in Genetics. By Raymond Pearl. Pp. vii+182. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

The Chemists' Year Book, 1916. Edited by F. W. Atack. Vol. i., pp. 354. Vol ii., pp. 355 to 990. (London and Manchester: Sherratt and Hughes.) 10*s*. 6*d*. net.

Union of South Africa. Report of the South African Museum for the Year ended December 31, 1915. Pp. 12. (Cape Town: *Cape Times*, Ltd.)

Canada. Department of Mines. Geological Survey. Memoir 58, No. 48, Geological Series: Texada Island, B.C. By R. G. McConnell. Pp. v+112. Memoir 72, No. 60, Geological Series: The Artesian Wells of Montreal. By C. L. Cumming. Pp. v+153. Memoir 76, No. 62, Geological Series: Geology of Cranbrook Map-Area, B.C. By S. J. Schofield. Pp. vii+245. Museum Bulletin No. 22, Geological Series, No. 31: The Age of Killarney Granite. By W. H. Collins. Pp. 12. (Ottawa: Government Printing Bureau.)

British Mycological Society. Vol. v., part 2: Transactions for the Season 1915. (Worcester: Baylis and Son.) 10*s*. 6*d*.

The Drink Problem of To-day in its Medico-Sociological Aspects. Edited by Dr. T. N. Kelynack. Pp.

xii+318. (London: Methuen and Co., Ltd.) 7s. 6d. net.

The *Athenaeum* Subject Index to Periodicals, 1915. Anthropology and Folk-Lore. Pp. 32. (London: *Athenaeum* Office.) 1s. 6d. net.

Rapport Annuel sur l'Etat de l'Observatoire de Paris, 1914. By P. Baillaud. Pp. 38. 1915. By P. Baillaud. Pp. 28. (Paris: Imprimerie Nationale.)

Les Racines des Plantes Herbacées. By A. P. Modestov. Livr. 1 (Publications 1–4). Pp. 138. (Moscow.)

The Bacterial Infection of Fresh Eggs. Bulletin 164. Agricultural Experiment Station of the Rhode Island State College, Kingston, R.I., U.S.A. Pp. 70 (Kingston, R.I.)

British Sea Fish. By H. Swithinbank and G. E. Bullen. Pp. xi+35. (London: Simpkin, Marshall and Co., Ltd.) 2s. net.

U.S. Department of Agriculture. Bureau of Biological Survey. North American Fauna. No. 37: Revision of the American Marmots. By A. H. Howell. Pp. 80+plates xv. No. 38: A Review of the American Moles. By H. H. T. Jackson. Pp. 100+plates vi. (Washington: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. lxii., No. 4: Hodgkins Fund. Reports on Wind Tunnel Experiments in Aerodynamics. By J. C. Hunsaker, E. Buckingham, and others. With five plates. (Washington: Smithsonian Institution.)

Smithsonian Miscellaneous Collections. Vol. lxiv., No. 3: Cambrian Geology and Paleontology, III. No. 3, Cambrian Trilobites. By C. D. Walcott. Pp. 157 to 258+plates 24 to 38. Vol. lxv., No. 14: The Sense Organs on the Mouth-parts of the Honey Bee. By N. E. McIndoo. Pp. 55. (Washington: Smithsonian Institution.)

United States Department of Agriculture. Report No. 108: The Acarina, or Mites. By N. Banks. Pp. 153. (Washington: Government Printing Office.)

Annals of the Missouri Botanical Garden. Vol. ii., No. 4. Pp. 659–841. (St. Louis, Mo.: Board of Trustees.)

University of Nevada Agricultural Experiment Station, Reno, Nevada. Bulletin No. 83, Technical: The Value of High-Level Meteorological Data in Forecasting Changes of Temperature. By Prof. S. P. Ferguson. Pp. 30. (Reno, Nevada: The University.)

The Daubeny Laboratory Register, 1904–1915, with Notes on the Teaching of Natural Philosophy, and with Lists of Scientific Researches carried out by Members of Magdalen College, Oxford. By R. T. Günther. Pp. x+139 to 292. (Oxford: Printed for the Subscribers at the University Press.) 7s. 6d. net.

Department of Commerce. Technologic Papers of the Bureau of Standards. No. 53: An Investigation of Fusible Tin Boiler Plugs. By G. K. Burgess and P. D. Merica. Pp. 37. (Washington: Government Printing Office.)

DIARY OF SOCIETIES.

THURSDAY, MAY 18.

ROYAL SOCIETY, at 4.30.—An Active Modification of Nitrogen: Hon. R. J. Strutt.—A Theory of Colour Vision: Dr. R. A. Houstoun.—Linkages Illustrating the Cubic Transformation of Elliptic Functions: Col. R. L. Hippisley.

ROYAL INSTITUTION, at 3.—Flints and Flint Implements: Sir Ray Lankester.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Notes on the Possibility of Ascending the Loftier Himalaya: Dr. A. M. Kellas.

CHEMICAL SOCIETY, at 8.—New Standpoints in the Chemical Study of Nutrition: Prof. F. Gowland Hopkins.

FRIDAY, MAY 19.

ROYAL INSTITUTION, at 5.30.—The Movements of the Earth's Pole: Col. E. H. Hills.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Spur-Gearing: D. Adamson.

SATURDAY, MAY 20.

ROYAL INSTITUTION, at 3.—The Finance of the Great War—New Problems and New Solutions: Prof. H. S. Foxwell.

MONDAY, MAY 22.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary General Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—Vibrations, Waves, and Resonance: Dr. J. Erskine-Murray.

TUESDAY, MAY 23.

ROYAL INSTITUTION, at 3.—Unconscious Nerves—their Functions in External Life: Prof. C. S. Sherrington.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Canoes of British New Guinea: Dr. A. C. Haddon.

ZOOLOGICAL SOCIETY, at 5.30.—The Structure of the Skull in Chrysochloris: Lieut. R. Broom.—Note on the Sternum of a Bird from the Eocene of Nigeria: Dr. C. W. Andrews.—A Mammalian Mandible from the Cretaceous of Alberta, Canada: Dr. A. Smith Woodward.—(1) List of Carabidæ (Coleoptera) from Chopersk District, South Russia; (2) A New Species of the Genus Platysma (Coleoptera) from China; (3) Notes on Species of the Genus Platysma from Australia: V. Lutshnik.

WEDNESDAY, MAY 24.

GEOLOGICAL SOCIETY, at 5.30.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—Zinc: Its Production and Industrial Applications: J. C. Moulden.

THURSDAY, MAY 25.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: X-Rays and the Theory of Radiation: Prof. C. G. Barkla.

ROYAL INSTITUTION, at 3.—The Beginnings of the Orchestra and its Instrumental Combinations: Sir Alexander Mackenzie.

FRIDAY, MAY 26.

ROYAL INSTITUTION, at 5.30.—X-Rays: Prof. C. G. Barkla.

SATURDAY, MAY 27.

ROYAL INSTITUTION, at 3.—The Finance of the Great War: Prof. H. S. Foxwell.

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THURSDAY, MAY 25, 1916.

CHEMISTRY FOR STUDENTS AND GENERAL READERS.

(1) *A Text-book of Elementary Chemistry*. By Prof. A. Smith. Pp. x+457. (London: G. Bell and Sons, Ltd., 1915.) Price 5*s*. net.

(2) *A Laboratory Outline of Elementary Chemistry*. By Prof. A. Smith. Pp. 152. (London: G. Bell and Sons, Ltd., 1915.) Price 2*s*. net.

(3) *A Text-book of Inorganic Chemistry*. Edited by Dr. J. Newton Friend. Vol. viii.: The Halogens and their Allies. By Dr. G. Martin and E. A. Dancaster. Pp. xviii+337. (London: C. Griffin and Co., Ltd., 1915.) Price 10*s*. 6*d*. net.

(4) *Modern Chemistry and its Wonders*. By Dr. G. Martin. Pp. xvi+351. (London: Sampson Low, Marston and Co., Ltd., 1915.) Price 7*s*. 6*d*. net.

(1) THOSE who have used, and appreciated the merits of, Prof. Smith's well-known "Introduction to Inorganic Chemistry" will study with interest his new "Text-book of Elementary Chemistry" and the "Laboratory Outline" which has been written as a companion to it. The published work of the author, and the brilliant results that have followed from his experimental researches, are a sufficient guarantee of the authenticity and accuracy of the statements of which the book is composed, and there is no lack of novelty in the range of subjects or in the facts which are quoted as illustrations. A perusal of the book has left in the mind of the reviewer some feeling of disappointment that the author has consented to be bound by the narrow restrictions involved in the compilation of one of the smaller elementary text-books. So many fascinating subjects are dealt with that one cannot help regretting again and again that a few lines in the text have had to carry a load which might well have been distributed over a page or a chapter. Thus the allotropy of sulphur, the constitution of water, the chemistry of petroleum, starch and sugars, enzymes and fermentation, the fixation of nitrogen, radioactivity and the inert gases of the atmosphere, pottery and cement, colloids and adsorption, fats and soaps, explosives and artificial silk, are all touched upon very briefly as illustrating the fundamental laws of chemistry or its applications to everyday life. Facts and observations such as these are amongst the most valuable assets of the lecturer, who can use them at his own discretion to cover with flesh the bony skeleton on which his subject is built up; some teachers at least will feel disappointed when they have to compete with a text-book in which the dry bones are already so amply covered with flesh. The attention of English teachers may be directed to the brief description given on pages 207 and 208 of the Frasch process of mining sulphur at the new township of Sulphur, Louisiana, where a quarter of a million tons of sulphur are pumped up every year in a molten state from beneath a quicksand with the help of superheated steam.

The book is illustrated by means of a series of simple, but very effective, line-drawings; there are also full-page portraits of Lomonossoff (the great Russian chemist, 1711–1765, whose forgotten work has been rediscovered to modern chemists by the aid of Prof. Smith himself), Mayow, Ramsay, Perrin (a charming and lifelike portrait), and Becquerel; a full-page illustration is also given of C. T. R. Wilson's photographs of fog-tracks from radium. The British edition contains two additional chapters, on the laws of chemical combination and the periodic classification of the elements, which have been added at the suggestion of Mr. H. A. Wootton, the senior science master at Westminster School.

(2) The "Laboratory Outline" calls for little comment, as it has been arranged to harmonise with and to illustrate the subject-matter of the "Text-book." Those who adopt the text-book will be glad to base their course of laboratory work on the "Laboratory Outline," and will find there an ample selection of suitable experiments and suggestions.

(3) Dr. Friend's new "Text-book of Inorganic Chemistry" promises to be a very valuable addition to chemical literature. Vol. viii. is the second, out of nine volumes, to reach the stage of publication, and as it is the first volume to deal systematically with an important group of elements, it may be regarded as establishing the kind of treatment that will be adopted throughout the series. The general result is extremely satisfactory, and will provide for English readers an even more useful guide to the literature of inorganic chemistry than they will find in the familiar Continental works of Moissan and Abegg. The chief features of the book, which arrest attention immediately, are the references given at the foot of almost every page to show the authority for the statements made in the text, and the generous treatment given to the physical properties of the various elements and compounds; manufacturing processes, such as the preparation of gaseous and of liquid chlorine, are also described in sufficient detail for an intelligent appreciation of the various operations which are involved. A wholly unnecessary prejudice is created in the introductory pages by numerous quotations from earlier publications of one of the authors, including in one instance an actual claim for priority; but this feature disappears as soon as the chapter on fluorine has been passed, and has no influence on the real utility of the book. Now that the supply of books and journals from the Continent has been so largely curtailed, it may be hoped that English chemists will take the opportunity of adding to their libraries the volumes of this most useful and creditable English text-book.

(4) It is difficult for a professional worker in any subject to review accurately a popular exposition of the "wonders" which form the familiar material of his "daily round and common task." The best criticism of such a work is obviously that of the general reader, for whom it is in-

tended; but the author's colleagues can at least bear witness to the fact that the wonders are described correctly, without exaggeration and without any undue appeal "to the gallery." Dr. Martin has probably been wise to assume that his readers are familiar with chemical formulæ, or that, even if they are not, they will still like to see these mystic symbols occupying a place in the text, as evidence that the book is a real contribution to chemistry, and not merely a misleading, if popular, exposition. The subjects dealt with include nitrates, explosives, petroleum, coal-tar, alcohol, sugar, and salt, whilst on the more theoretical side are chapters on radium, on modern alchemy, and on the "mystery of the periodic law." Only in the case of these last-mentioned chapters does any doubt arise as to the ability of the general reader to appreciate the author's exposition; but that is a question that may soon be solved when the book has circulated as widely as its merits demand. Here and there the burning questions of the day are touched upon—the underpayment of chemical workers generally, and especially of those who are willing to undertake the burden of original research; the discouragement of research by the undue prolongation of examination tests at the universities; the loss of the coal-tar industries; and the risk that freedom of thought may be hampered by the creation of "immensely rich and immensely powerful international scientific societies." These questions, discussed in a popular book on the wonders of modern chemistry, may perhaps drive home a lesson which has not yet been fully learned by a public unversed in the literature of presidential addresses to technical and scientific societies. The book contains thirty-six excellent plates and twenty-nine drawings in the text. T. M. L.

WIRELESS TRANSMISSION OF PHOTOGRAPHS.

Wireless Transmission of Photographs. By M. J. Martin. Pp. xi+117. (London: Wireless Press, Ltd., 1916.) Price 2*s*. 6*d*. net.

THE problem of transmitting pictures by wireless is not one of actual performance, but of speed of transmission. It is obvious that a "process" picture, one inch square, consisting of some 2000 dots of, say, six different sizes, could be transmitted and set up as "letterpress" in the time it takes to transmit and set up half a column of NATURE. The task which Mr. Martin faces is, therefore, the task of bringing the speed of transmission within commercially manageable limits. He does this by means of an apparatus which transmits more than 5000 dots a minute.

This transmission is effected by current impulses produced by the contact of a metal point travelling over a metal positive of the picture, consisting of bichromated gelatine on tin- or lead-foil. Wherever the stylus touches the foil it produces a current impulse in the transmitting antenna. At the receiving station these impulses are photographically recorded on a revolving drum synchronised with the drum on which the transmitted metal picture is fixed. The size adopted is 5 by 7 inches, and the time required for transmission is said to be twenty-five minutes. This is short enough for practical purposes, but very considerable skill is required to prepare the metal prints, and the whole "telephograph" consists of an array of different apparatus, each requiring very careful adjustment. The author acknowledges, indeed, that the process is still in the purely experimental stage.

The book is useful as giving a general survey of the present state of the problem and some guide towards future experimentation. It should be remarked, incidentally, that the sensitiveness of the Einthoven galvanometer is greatly understated, 10^{-8} ampere being quite a strong current for the larger quartz-fibre instruments. Selenium and the preparation of the metal prints are dealt with in separate appendices. The only method of preparing Se cells described is Bell and Tainter's method with brass electrodes, which, of course, are quite unsuitable, and are never used nowadays. The definition of sensitiveness as the ratio between resistance in the dark and resistance "when illuminated" is too vague to be useful, and should be replaced by some less ambiguous statement.

The electrolytic receiver described on p. 54 as "the most practical and simple of all photo-telegraphic systems" is remarkably ingenious, though its simplicity is not very obvious. Like the rest of the book, it gives an impression of the great difficulties encountered and the amount of ingenuity already expended on them. E. E. F.

ELECTRICAL ENGINEERING MANUALS.

(1) *Examples in Magnetism.* Second edition. Pp. 90. Price 1.10 dollars.

(2) *Examples in Alternating Currents.* Vol. I. Second edition, with additions. Pp. 223. Price 2.40 dollars.

(3) *How to Make Low-pressure Transformers.* Second edition, with additions. Pp. 17. Price 40 cents. All by Prof. F. E. Austin. (Hanover, N.H.: Published by the author, 1915-1916.)

(1) OUR opinion of this book is distinctly unfavourable. The substance is poor in quality, and its quantity is much less than many better books at half the price. In his very first numerical examples the author shows that he has no sound grasp of the real use of numbers in connection with measurements; and he further displays his deficiency by stating that "1 foot-pound *exerts a force* (our italics) of 13,549,213·44 ergs," in spite of the satisfactory definition of "force" appearing on the next page. Although he starts with four-figure data (30·48 cm. = 1 ft., 453·6 grams = 1 lb., g = 980 cm. per second per second), he has worked this out to no fewer than ten significant figures! Such a procedure is unpardonable in one who proposes to "give

guidance" to others. We have noted quite a number of points like this, but it would be a waste of time and space to refer to them in detail.

(2) "It is the design of this book to furnish guidance" to the "college student" and to "those who are pursuing a correspondence course" "in the solution of engineering problems." The first forty pages or so contain a *résumé* of the mathematical and trigonometrical formulæ likely to be required. This is certainly useful, but much of it should not be necessary to students whose mathematical attainments are sufficient to follow the methods employed in the book, which make free use of the calculus, and seem to prefer pure trigonometrical solutions to those obtained with the help of vectors. Then follow a number of definitions concerning alternating quantities and elementary electrical matters. The uninitiated reader should be warned that some of these give quite a different meaning to certain terms from that current in this country, and others, if strictly interpreted, do not express quite what the author presumably intended. The book, however, is not intended as a text-book, but as a book of examples, and if the student conscientiously works through all the examples and problems given, he can scarcely fail to gain a fair insight into alternate current theory.

(3) The amateur or student who wishes to make a small transformer for himself will find the construction of the little one described in this book well within his powers. The type chosen is the Faraday ring type, which is an efficient type for its size, and is suitable for making with somewhat limited resources as to tools. The type does not, however, lend itself to cheap factory construction, and the book is not intended for electrical engineers. D. R.

AN AMERICAN GARDENING BOOK.

My Growing Garden. By J. H. McFarland. Pp. xiii+216. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.

IT is the better sort of intellectual morality which has inspired the writer of "My Growing Garden." As its title suggests, it begins *ab initio,* almost *in principio,* and the whole book bubbles over with the enthusiasm of the genuine gardener who creates, aspires, and sometimes has to stoop to conquer. The shrewd common sense that underlies some of the passages, which a meticulous critic might perhaps describe as otherwise florid, has a pleasant American character, and gives the book a quality of its own.

It is quite possible that the English garden-lover may not be able to extract many special "wrinkles" from Mr. McFarland's book, but he will most surely derive a good deal of pleasure from an acquaintance with the American garden as it has developed under the care of an American enthusiast. The chapter on weeds is especially a pleasant one, and, indeed, the whole book is well worth the reading.

One of the oddly deep-rooted tendencies that Adam has transmitted to his descendants is a love of the garden. Like other tendencies, it may be latent in some, but is continually cropping up after the fashion of other primal instincts. Now and again it bursts into widespread activity, which is perhaps more than genuine; for imitation, a pre-Adamite simian character, plays no small part in the ostensible development, mental, moral, and otherwise, of gregarious folk. One of the accompanying features of the present epoch, symptomatic, perhaps, of the proselytising spirit of aggressive humanity, is apparent in the multitude of books on gardens which have, for the last decade or so, been rolling so tumultuously from the printing press. The future student of our times might do worse than give his attention to this oddly mixed literature. It has been written by and for all sorts and conditions of men—and women—and it reflects, as the serious, fictitious, or mercenary pursuit of a widely cultivated hobby can do so well, a wide range of human aspiration —a curious mixture of noble metal and worthless clay. J. B. F.

OUR BOOKSHELF.

Elements of Mineralogy. By F. Rutley. Revised by H. H. Read. Nineteenth edition. Pp. xxii+394. (London: T. Murby and Co., 1916.) Price 3*s*. 6*d*. net.

IN this nineteenth and extensively revised edition of Rutley's "Mineralogy" the general arrangement of the original has been largely retained, but such changes have been made as the reviser has thought necessary "to bring the book into line with modern tendencies in economic mineralogy, and to make it an introduction to the scientific prospecting and determination of mineral deposits."

Occurrence and origin are treated more fully than in former editions, also the uses of the industrial minerals, and the geographical location of important deposits. An interesting introduction has been contributed by Mr. G. T. Holloway, and a series of excellent paragraphs prefatory to the several useful and precious metals by Mr. W. G. Wagner. A serviceable glossary of terms used in economic geology has been added by the reviser.

Typographical errors are few, but errors of matter numerous. The composition of anorthite is given as $CaO.Al_2O_3.6SiO_2$ (p. 191); it is stated of orthorhombic crystals (p. 111) that "all sections give straight extinction"; ægerine and wollastonite are classed with the aluminous pyroxenes (p. 198), and riebeckite with the aluminous amphiboles (p. 206). Style, and precision of language, too, are often defective. The tetragonal system is characterised by "two equal lateral axes, one unequal vertical axis" (p. 71); the optic axes of biaxial crystals are described as directions "along which light can travel with equal velocity" (p. 90); the Mond process is said to produce "nickel in a great state of purity" (p. 338); we are told (p. 116) that "iron carbonate ($FeCO_3$) is the mineral chalybite," and (p. 376) that platinum is used "in

the manufacture of chemicals by the contact process in dentistry and in jewellery."

Mr. Read was ordered abroad for active service while the volume was being set up. Had he seen all proofs, no doubt imperfections, of which the foregoing are random examples, would have been eliminated.

The book is a useful epitome of mineralogical principles and methods, and a convenient small work of reference to the more important rock-forming and economic minerals. C. G. C.

British Sea Fish: An Illustrated Handbook of the Edible Sea Fishes of the British Isles. By Harold Swithinbank and G. E. Bullen. Pp. xi + 35. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.) Price 2*s.* net.

THIS is a pamphlet of which six pages are devoted to an account of the British sea fisheries, and thirty-five pages to descriptions of some thirty-four species of marketable fishes. The illustrations are very small half-tone reproductions of mediocre photographs. The descriptions consist each of about six to ten lines of print summarising the characters of the species; two or three lines of print giving the range of occurrence; and of "remarks" dealing mainly with the quality, flavour, and methods of cooking of the fishes considered. We learn from the preface that the work "is to be regarded as in no way scientific," and that it is intended to popularise the cheaper and coarser kinds of sea-fish which at present suffer from prejudice. Considering these limitations and the relatively high price of the pamphlet, we find it difficult to think of the particular public to which it is intended to appeal at the present time; for it is far too small to be of much use to anyone really interested in marine biology, and too expensive to be used in a propaganda.

J. J.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

"Summer Time" and Meteorology.

RECENTLY I have had occasionally to rise at 3 a.m. and to be out between 3 a.m. and 5 a.m. I found the weather misty and relatively very cold, with temperature about 45° F. Later in the day temperature rose to 75° F. Clothing suitable for the early morning was quite unsuitable for the day, and (what I specially noticed) *vice versâ*; it occurred to me that civilised people had unconsciously adopted a day which centred a little later than the time of maximum temperature, thereby securing the nearest possible approach to a uniform temperature in the daily period of their "away from home" existence. In this way they save themselves unnecessary trouble in putting on and taking off clothing; and, further, they save themselves unnecessary risk of chills and colds. The change from a temperature of 45° F. to one of 75° F. is equivalent to changing from a cool day of January to a warm day of July. The change may stimulate and energise the labourer in the fields; I doubt if its effect on the worker in a city office is good or pleasant.

The average increase of temperature from 8 a.m. to 9 a.m. in the summer months is nearly 40 per cent. of the increase from 9 a.m. to the maximum about 2 p.m.; and the decrease in humidity (or dampness of the air) from 8 a.m. to 9 a.m. is nearly 50 per cent. of the decrease from 9 a.m. to the minimum humidity in the afternoon (and the rate of change from 7 a.m. to 8 a.m. is equally fast).

Moving the hands of the clock will neither warm nor dry the air. People are therefore being plunged into cooler, damper air through their ignorance (1) of the fact that custom is usually based on the teachings of experience; (2) of the facts of observation which indicate directly what has been the indirect teaching of experience in this case.

The argument that it is as cold in April at 9 a.m. as it is in May at 8 a.m. is ineffective, because people in England adapt the amount and character of their clothing to the season of the year, and what they feel most is not absolute cold, but relative cold; and *relatively to the middle of the day* it is twice as cold at 8 a.m. in May as at 9 a.m. in January.

There is an element of romance about early rising if the experiment is not too often repeated. Perhaps one summer will suffice. E. GOLD.

IN accordance with the provisions of the Summer Time Act, Greenwich Mean Time will continue to be used for all meteorological observations and publications, so that no discontinuity will be caused during the period when Summer Time is in force. But besides the observations which are made by regular observers, many meteorological phenomena of various kinds are from time to time recorded or reported, and it is highly desirable that there should be no ambiguity in these reports, which are often of much interest and importance. The council of the Royal Meteorological Society desires to direct attention to the necessity of stating precisely the time of occurrence in all such cases, and whether the times quoted refer to Greenwich Mean Time or to Summer Time, since the omission of this information may render the record of the phenomenon useless for meteorological purposes.

Such occasional observations form a valuable addition to those which are made at the permanent observing stations and supplement them usefully; it is therefore essential that they should be recorded with precision. H. G. LYONS,
President.

Royal Meteorological Society, May 19.

Geologists and Special Constables.

A RECENT experience of Canon E. Hill and myself may be useful to geologists. On May 3 we went by train from Lincoln to East Barkwith Station, on the line to Louth, and walked by a rather roundabout route to South Willingham Station, looking at the structure of the country and for sections of drift. While waiting for our train outside the latter station, a man, in dress and aspect rather above a farm labourer, accompanied by another with a badge of some sort on his coat, came up to us, and in none too civil a tone began to catechise us as to what we were doing, where we were and had been staying, our homes, professions, ages, heights, and the like, about which we gave him full information. Apparently he did not know that there was such a science as geology, but after he had received a large amount of biographical information he acknowledged it by saying, in the tone of one rebuking two peccant villagers, that as

educated men we ought to have known we had no business to be going about the country. This was rather too strong, so I retorted, "That is nonsense; we have a right to take a walk along the roads to see the country." To cut a long story short, he departed, before our train arrived, with the remark that, if we had been photographing or sketching, he should have taken us into custody.

We were at nearest about seventeen miles from the sea. Neither at Louth (where we had spent a week) nor at Lincoln was any notice posted up in the hotel (or elsewhere, so far as we had seen) supporting his view, and we had not left the high road, except to enter two pits. It is therefore obvious that any village Dogberry may employ the "brief authority" with which he imagines himself clad to prevent all study of English geology or natural history.

T. G. Bonney.

National Food Supply and Nutritional Value.

One of the remarks made in the article in Nature of May 11 on my survey of the "Food Value of Great Britain's Food Supply" is certainly justified, namely, "the value for protein seems low." It is too low. This has arisen from taking an analysis for wheat flour in which the protein was 7·9 per cent., whereas it should be, more correctly, something like 10·7 per cent. Making an allowance for this difference increases the daily protein ration per man by 10·4 grams and brings it to 112·1 grams instead of 101·7. For a similar reason the carbohydrate should be reduced from 587·12 grams per man per day to 580·7 grams. Whether the fat should be reduced depends on the analysis adopted for the different kinds of meat. A recalculation, however, adopting different analyses, and perhaps, on the whole, more accurate ones, makes no material difference in the daily ration "as purchased." It certainly affords no ground for reduction; on the contrary, it shows an increase of 1·9 grams per man per day.

In conclusion, perhaps I may be permitted to express my grateful appreciation of the very fair and sympathetic way in which your article, as a whole, is written and for the opportunity it affords of making these corrections, which I hope to publish later in detail.

W. H. Thompson.

Trinity College, Dublin, May 15.

I am glad to find that Prof. Thompson has discovered a reason for giving us a more reassuring figure concerning the national supply of protein. It is now clear that we have a larger margin upon which to draw in case retrenchment should prove necessary.

Readers of Nature should be grateful to Prof. Thompson for making the correction, and I have myself to thank him for the courtesy of his letter.

The Writer of the Article.

May 19.

The Lower Greensand Flora.

In the kind review of my work on the Lower Greensand Flora in Nature of May 4 your reviewer states that I have overlooked a memoir by Buckland. This is the Bridgewater treatise. May I point out (1) that I was dealing with Lower Greensand and not Portland Oolite plants, and therefore not professing to give a complete account of the latter, but merely referred to Buckland's *original* memoir, in which the name of the genus was founded, for purposes of nomenclature; (2) that, even though in the later work (the Bridgewater treatise) Buckland figures a specimen with the "lateral buds," which are probably cones, it remains the fact, as I stated, that no cones are figured in the original *type*; (3) that the Bridgewater treatise example can only be accepted as being the same species as the original type by an assumption that they were, in fact, identical, because, as I stated, the original type specimen is lost; (4) that, consequently, it is not carelessness, but a perhaps over-meticulous scrupulousness in nomenclature which made me, and still makes me, hesitate to accept as a certainty the identity of the so-called *Cycadites microphyllus* of the Bridgewater treatise with the lost original vegetative type of *Cycadeoidea microphyllus*, in spite of the top part of the drawing.

Marie C. Stopes.

Overlooking a reference is at least to some of us too common an occurrence to need an elaborate defence. My point is that Buckland's later description of one of his species, *Cycadeoidea microphylla*, is fatal to an important argument used by Dr. Stopes. Buckland expressed no doubt as to the specific identity of the specimen figured in the Bridgewater treatise with that on which the original account was based, and, whether or not the stems belong to the same species, there are no adequate grounds for doubting their generic identity. The natural course to pursue in endeavouring to solve a problem is to consider such evidence as is available, and, as regards the question at issue, I maintain that the evidence overlooked by Dr. Stopes furnishes a serious—in my opinion a fatal—objection to her conclusions.

A. C. S.

Meteorological Conditions of a Blizzard.

The word "blizzard," signifying originally a type of snowstorm most common and most severe in the Rocky Mountain States of the Union, although occasionally occurring elsewhere, is now loosely used to mean any heavy snowstorm. This is unfortunate, for a term is needed for the type of storm referred to above. Three things must co-exist in a blizzard—large quantities of very fine snow; very low temperature, generally below zero Fahrenheit; and a high wind of great velocity.

Apparently the loose use of the word is becoming common in Great Britain, for you refer in Nature of April 6 (p. 129) to "a blizzard of unusual severity." The context shows that neither the snow nor the temperature condition could have been fulfilled, for you say that the gale "was accompanied by *rain* and snow."

I doubt very much whether the British Isles could produce the requisite conditions for a real blizzard.

Arthur E. Bostwick.

St. Louis, Mo., April 24.

THE ROUTLEDGE EXPEDITION TO EASTER ISLAND.

Now that members of Mr. Scoresby Routledge's expedition to Easter Island have returned to this country, it is possible to give some idea in broad outline of the objects of the expedition and of its chief results. The expedition, which was aided by grants from the British Association and the Royal Society, was exceptionally well equipped. It also had the advantage of being independent of the infrequent opportunities of communication with Easter Island, as Mr. Routledge had built and fitted at his own expense the schooner *Mana*, of 126 tons, with auxiliary motor power, in which the expedition sailed from

Southampton to Chile *viâ* the Straits of Magellan, and thence to its destination. The party consisted of Mr. and Mrs. Routledge, Lieutenant R. D. Ritchie (seconded by the Admiralty for navigation and survey work), and Mr. F. Lowry Corry, geologist. The last-mentioned gentleman had unfortunately to be left behind in South America owing to a severe attack of typhoid fever which necessitated his subsequent return to England. The expedition arrived at the island on March 29, 1914, and did not leave until August, 1915, making a stay of sixteen and a half months.

Easter Island, or Rapa Nui, the most easterly island of the Polynesian group, lying about 11 miles south-east of Pitcairn, was discovered in 1721 by a Dutch captain named Roggewein. It was visited on several occasions subsequently by navigators, notably by H.M.S. *Topaze* in 1868. Our knowledge of the history and antiquities of the island is based largely on the results of a visit of twelve days' duration made by the *Mohican*, of the United States Navy, in 1886.

The islanders speak a dialect of Polynesian, and in physical character they conform to the Polynesian type. At the present day their numbers are small, owing to the fact that in 1862 or 1863 about half of the population was carried off by Chilian slave raiders, and a large number of the remainder were transferred to Tahiti, Eimeo, and Gambier by various agencies. Considerable modification in their customs would appear to have taken place after the Chilian raid; the chiefs upon whom their social organisation was based disappeared, and many of their ancient customs fell into desuetude, though the tradition was preserved among the older members of the community. From this tradition and from the references in the accounts of the older voyagers, it would appear that in religion, culture, and social organisation the Easter Islanders were broadly Polynesian. During their stay on the island the members of the Routledge expedition were able to get into intimate relation with those islanders who still have some knowledge of the older tradition. The result has been a fund of information of quite unhoped-for interest and importance, especially in its relation to the archæological remains of the island, which have always been something of a puzzle.

The chief interest of Easter Island lies in the fact that it possesses remains which, although not exactly unique, are yet sufficiently remarkable to have given rise to considerable speculation. These consist of stone terraces, or platforms, resembling the Polynesian *marais*; colossal monolithic statues, stone carvings, and stone-built houses. Further, Easter Island is the only part of Polynesia in which anything approaching a script was developed. About fifteen inscribed wooden tablets from the island are known to exist, one being in the British Museum.[1]

The stone terraces or platforms have been carefully examined and measured by the Routledge expedition, and the number known to exist has now been considerably increased. These platforms are remarkable both for their size—one of them is 150 feet long, or with the wings which run from the upper level to the ground, 560 feet long—and for the method of their structure. They were built by filling in with stone rubble the space between parallel walls of squared uncemented stone. On the top of the platforms stood the stone statues. These statues, of which there are two examples in the British Museum, are of enormous size, weighing from 10 to 40 tons. Many of them lie where they were made in the crater, and a large number still stand on the slopes of Rana Roraku, one of the volcanic craters which form the chief physical features of the island. Dr. Rivers has recently directed attention to the fact that Moerenhout in 1837 pointed out that similar, though smaller, statues existed in Pitcairn and Laivaivai, while he himself suggests a connection with the cults and secret societies of Melanesia.[2] None of the statues on the platforms are now standing, and their manufacture appears to have ceased abruptly. One explanation of the cessation which has been offered is that it was due to a volcanic disturbance, while a native legend states that the statues were thrown down in an intertribal quarrel. The Routledge expedition made a number of excavations around the statues in the hope that light might be obtained on this point, and the methods of manufacture were carefully investigated. Particular attention was given to the question of orientation, but no uniformity was observed. On the coast the statues on the platforms faced inland, while the platforms themselves faced in all directions. Those erected on the mountain followed the nature of the ground. Inside the crater they faced north and east; on the outer slope south-west. The stone-built houses were also subjected to a close examination, and much new information obtained as to them. It could scarcely be expected that at this late date, especially having in view the results of earlier inquiries, an interpretation of the tablets could be obtained; but a certain amount of information of value has been acquired.

The expedition, on leaving Easter Island, visited Pitcairn Island (where a stay of four days was made), Tahiti, and the Sandwich Islands, in all of which material valuable for comparative purposes was obtained.

It would be premature and unfair, while the data of the expedition are still under examination, to do more than indicate in the briefest manner the points to which attention has been directed. Enough has been stated, however, to suggest the value of the expedition's work, which it may safely be said will not only add considerably to our knowledge of the island itself, but will have important bearing upon more general questions relating to the culture of the Pacific. It is hoped that it will be possible for a full account of the expedition to be given at the forthcoming meeting of the British Association at Newcastle.

E. N. FALLAIZE.

[1] The tablets are described and the attempts at their interpretation summarised and discussed by Mr. O. M. Dalton, "On an inscribed wooden tablet from Easter Island (Rapa Nui) in the British Museum." *Man*. London, 1904. No. 1.

[2] W. H. R. Rivers, "Sun Cult and Megaliths in Oceania." *American Anthropologist*, New Series, 17, 1915. 442 fol.

THE BRITISH SCIENCE GUILD.

THE tenth annual meeting of the British Science Guild was held at the rooms of the Royal Society of Medicine on May 17, when the Rt. Hon. Sir William Mather (president of the Guild) presided over a large attendance, including many well-known men of science.

In moving the adoption of the annual report the president referred to the past work of the British Science Guild in encouraging the practical applications of science—a matter the importance of which had been acutely realised since the outbreak of war. Many instances are furnished in the report. It will be recalled that public interest in this question was aroused by an address delivered by Sir William Ramsay on the organisation of science at the annual meeting in 1915. This subject has since received constant attention by the executive committee, and useful work has also been done by the various special committees of the Guild. A journal is now being issued periodically summarising the work of such committees and other matters of general interest to members of the Guild.

It is remarked that the need for the proposed National School of Technical Optics has been strikingly illustrated by the difficulty, since the outbreak of war, in securing adequate supplies of binoculars, prismatic compasses, gun-sights, periscopes, range-finders, and other "optical munitions." A resolution urging the national importance of such a school was passed by the executive committee of the Guild on December 7, 1915, and forwarded to the Ministry of Munitions, but notwithstanding the assurance of the Minister that "the object in view appears to be undoubtedly of the greatest importance," the necessary funds for this purpose are not yet forthcoming. Committees are also engaged in studying the manufacture of British microscopes for pathological, chemical, and metallurgical work; and a special committee has outlined a programme of policy of State relationship to industry, science, and education. This memorandum will be issued in due course.

The annual report contains a survey of the various science committees working on war problems, the steps taken by various scientific societies to put their members at the service of the Government for scientific work, and other proposals of interest during the year. Reference is made to the recent meeting following the memorandum on "The Neglect of Science"; the conference called by the Royal Society with the view of establishing a conjoint board of scientific societies; and the work of the advisory council to the committee of the Privy Council for the organisation of scientific and industrial research. In an appendix, compiled by Prof. R. A. Gregory, the work of the advisory council is more fully described and a summary is given of the scheme for the establishment of a Commonwealth Institute of Science and Industry in Australia. This appendix also contains a review of the Civil Service estimates for education and science, and some particulars of benefactions to science and education in the United States. During the period 1871–1914 no less than 116,883,000*l.* was given in private donations for these purposes. In the year 1913–14 six universities benefited to the extent of more than 200,000*l.* each, Cornell University receiving 875,220*l.* The average annual benefactions for educational purposes amount to nearly six million pounds. The report as a whole furnishes an extremely interesting review of progress during the past year—a year which may prove a very important one in the history of British science.

The adoption of the annual report was seconded by Dr. R. Mullineux Walmsley, who gave some instances of our present deficiency in facilities for the manufacture and application of optical glass. He recalled that the scheme for the National School of Technical Optics, originally matured by the governors of the Northampton Institute, was placed before the educational authorities thirteen years ago. Had this school been in existence when the war opened, it could have rendered exceedingly valuable service. In appealing for 40,000*l.* to cover the building and equipment of the school Dr. Walmsley read a letter from Mr. Lloyd George agreeing that a National School of Technical Optics was urgently needed, and commending the scheme to the generous consideration of patriotic citizens.

An address was delivered by the Rt. Hon. Andrew Fisher, High Commissioner for the Commonwealth, on the establishment of a National Institute of Science and Industry in Australia. Since the war Australia had learned to appreciate the value of organised science. The laboratory was the adjunct of the workshop. Science, added Mr. Fisher, should be more adequately represented in the Government of this country, and mere attachment to tradition should not interfere with the realisation of this aim. The scheme for the National Institute of Science and Industry was based on co-operation. The conference called last January had received the combined support of men of science, manufacturers, and representatives of the chief State departments, and in a fortnight had evolved a definite scheme. The institute will be under the supervision of three directors, free from political control, one of whom will be a man of proved ability in business and finance, and the other two men of science of high standing. The institute will encourage and initiate researches in the chief colleges and laboratories throughout the country, establish research fellowships, and create new institutions where necessary. It is also proposed to organise a bureau of information, which will act as a clearing-house for intelligence of scientific and industrial value, will help to avoid overlapping of effort, and will promote the interchange of experience between men of science and manufacturers. Among the subjects to be investigated will be many of great importance to Australia connected with metallurgical, chemical, and agricultural matters and the utilisation of waste pro-

lucts. Important work might also be done in studying the development of districts differing widely in climate and temperature.

A vote of thanks to Mr. Fisher was proposed by Sir Alfred Keogh and seconded by Sir John S. Young. Sir Alfred Keogh expressed the hope that the scheme described by Mr. Fisher would be instrumental in promoting constant interchange of views between men of science in this country and in Australia. As an illustration of the practical applications of science, Sir Alfred referred to the care of the wounded and their treatment during convalescence. A striking instance had been the suppression of typhoid fever. To-day there are only twenty-two cases in the British Army in France, whereas if we had gone on in the old way the number of cases would probably have reached 80,000 or 100,000.

The Lord Mayor and Mr. Andrew Fisher have been elected vice-presidents of the Guild; and the Executive Committee for the year 1916–17 is constituted as follows:—President, Right Hon. Sir William Mather; chairman of committees, Sir Norman Lockyer, K.C.B., F.R.S.; vice-chairmen of committees, Sir Hugh Bell, Bt., Hon. Sir John Cockburn, K.C.M.G.; honorary treasurer, Right Hon. Lord Avebury; honorary assistant treasurer, Lady Lockyer; deputy chairman, Sir Boverton Redwood, Bt.; vice-presidents, Sir William Phipson Beale, Bt., K.C., M.P., Surgeon-General Sir Alfred Keogh, K.C.B., Major O'Meara, R.E., C.M.G., Right Hon. Lord Sydenham, G.C.M.G., G.C.S.I., F.R.S.; hon. secretaries, Sir Alexander Pedler, C.I.E., F.R.S., Dr. F. Mollwo Perkin; other members, Captain Bathurst, M.P., Dr. G. T. Beilby, F.R.S., Mr. W. H. Cowan, M.P., Prof. R. A. Gregory, Sir Robert Hadfield, F.R.S., Prof. A. Liversidge, F.R.S., Sir Philip Magnus, M.P., Dr. T. A. Matthews, Mr. Robert Mond, Prof. John Perry, F.R.S., Sir Ronald Ross, K.C.B., F.R.S., Mr. Alan A. Campbell Swinton, F.R.S., Lady Napier Shaw, Mr. Carmichael Thomas, Dr. R. Mullineux Walmsley, Dr. Howard S. Willson, and Colonel Sir John S. Young, C.V.O.

NOTES.

THE Summer Time Bill received the Royal Assent on May 17, and came into force at 2 a.m. on Sunday, May 21. From now until the end of September three systems of time-reckoning will be legal, namely, (1) Greenwich Time, for tides and other occurrences of navigation and astronomy; (2) local time, which is based on distances from Greenwich in latitude and longitude, and determines lighting-up times; and (3) Summer Time; which is an hour in advance of Greenwich Mean Time. The third clause of the Act states that "during the prescribed period any expression of time in any Act of Parliament, Order in Council, order, regulation, rule, or by-law, or in any time-table, notice, advertisement, or other document, is to mean 'Summer Time.'" Orders as to lighting-up must, however, be excluded from the field of operations of this clause, as they refer to an interval and not to a particular hour. Time-tables showing lighting-up times in different parts of the kingdom are in common use, and are given in many calendars and almanacs. These times are determined by actual sunrise or sunset as points of reference, being at present half an hour before and after respectively. The sun rises to-day, for example, at nearly 4 a.m. in London and sets a little before 8 p.m.; lamps of vehicles must, therefore, be lighted up to 3.30 a.m. G.M.T., and after 8.30 p.m. The corresponding times at Glasgow are 4.38 a.m. for sunrise, 8.38 p.m. for sunset, and lighting-up times to about 4 a.m. and after 9 p.m. All these times are ultimately based on Greenwich Time, with the necessary differences; and it will be a problem for many a village policeman to decide when lamps have really to be lighted. *Symons's Meteorological Magazine* for May, in an article deploring the adoption of the measure, prints a letter from Sir Napier Shaw, director of the Meteorological Office, instructing observers to record their observations and attend at their offices and observatories according to the hours of Greenwich Mean Time, as heretofore, which shows that in the Government meteorological service the Act is simply to be ignored, as it must be in meteorological work generally. So far as we know, not a single daily paper has shown an intelligent appreciation of the relation of daylight to time-standards, but we are glad to acknowledge that, in the technical Press, the *Electrical Review* has consistently condemned the principle involved in the new measure, as well as contested the claims put forward by its advocates. It remains to be seen whether the promised social and economic advantages of the Act will justify the use of Summer Time over the whole kingdom either during the war or after.

AT a meeting held at Burlington House on May 23, attended by representatives of many leading firms concerned with chemical industries, it was resolved that British firms engaged in the chemical and allied trades should form an association (1) to promote closer co-operation and to place before the Government the views of the chemical trade generally; (2) to further industrial research; and (3) to facilitate closer co-operation between chemical manufacturers and various universities and technical schools.

IN an interesting and suggestive address delivered at the inaugural meeting of the Ferrous Section of the Metallurgical Committee of the Advisory Council for Scientific Research on May 8, Sir Robert Hadfield put forward a proposal for the establishment of a Central Bureau of information as to materials existing within the British Empire. As he pointed out, when it is a question of the adoption of a new metallurgical invention or development, it is absolutely necessary to know the locality and extent of the materials which will be required. Neither the work of the Geological Survey, nor that of the Department of Mines in the Home Office, nor that of the Imperial Institute really covers this field. It is true that Dr. Strahan, the director of the Geological Survey and Museum, Jermyn Street, has recently begun the issue of a series of special reports on the mineral resources of Great Britain. But something very much broader and bigger than this is required. How restricted is the scope of activities of the Geological Survey may be illustrated from the fact that it does not include Ireland. The ores existing in that country are not known officially in this country at all; and the basis of such information as does exist rests upon the partial work of one man, who is remunerated to the extent of 100*l.* per annum. Moreover, the maps issued by the Geological Survey in this country do not furnish sufficient information as to minerals of economic value. With proper organisation the value of metallurgical products within the British Empire could be very

greatly increased, and the proposal made by Sir Robert Hadfield as to the necessity of a Central Imperial Bureau of information is one that will receive the support of everyone acquainted with the actual state of affairs revealed as the war has progressed.

On the invitation of Sir Alfred Keogh, rector of the Imperial College of Science and Technology, about fifty members of the Commercial Committee and other members of Parliament visited the college on May 18. Mr. Arthur Acland, the chairman of the Executive Committee of the governing body, welcomed them on behalf of the governors, and gave a short historical account of the college, with particulars of the staff, students, and buildings. Referring to education at public schools, Mr. Acland said that boys came to the college very ill-prepared to take up scientific studies; this no doubt was largely due to the bias in favour of the classical as against the modern or scientific side still existing in most schools, and he urged upon the members of Parliament present the necessity of a full inquiry into our public-school system. Dealing with higher education, he showed how technical training had suffered in the past from lack of funds, and the haphazard manner in which successive Governments had dealt with it. In this country there were no benefactions to education on the scale of those given in the United States, nor large State grants as in Germany. He referred to the sites still unbuilt upon in the Imperial College owing to want of money, and made a strong appeal for the development of scientific institutions generally. It was important that development should be systematic, with a view to the future needs of the Empire. On the conclusion of Mr. Acland's speech, the committee proceeded to inspect the departments, including those of chemistry, physics, fuel technology, engineering, mining, metallurgy, geology and oil technology, and plant physiology and pathology. After the tour the members met at the Imperial College Union, and the rector, in reviewing the purposes of the college, illustrated the country's recent dependence on Germany for highly trained men of science by mentioning that when he first came to the college students who had been trained in botany were obliged to go to places like Munich for training in plant physiology and pathology, and that a regular employment agency for economic botanists for the British Empire existed at that time in Berlin. This was now changed by the action of the college. He urged industrial people to bring their industrial problems to the college, where they would be worked out for them. On behalf of the commercial committee, Major Chapple and Sir Archibald Williamson expressed their thanks and the great pleasure the visit had afforded them.

The annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 3.

Sir Alfred Ewing, F.R.S., Director of Naval Education, has been appointed principal of the University of Edinburgh, in succession to the late Sir William Turner.

On Thursday, June 22, the Royal Society's Croonian lecture will be delivered by Prof. S. J. Hickson, on "Evolution and Symmetry in the Order of the Sea-pens."

We learn from the *Times* of May 20 that the archæologist, Dr. P. V. Nikitine, vice-president of the Russian Academy of Sciences, died on May 18 in Petrograd.

The Rev. J. Llewelyn Davies died on May 18 at Hampstead at ninety years of age. Mr. Davies was an original member of the Alpine Club, and made the first ascents of the Dom and the Täschhorn. He was elected one of the members of the first London School Board in succession to Huxley. He was associated with F. D. Maurice in the foundation of the Working Men's College in 1854, and was for a time principal of Queen's College, Harley Street, London, W.

The band of the Coldstream Guards will play at the Royal Botanic Gardens on Saturday and Sunday afternoons during the season, commencing June 3. Future arrangements include the National Rose Show and other events of botanical, social, and charitable purpose.

The death has occurred of Dr. T. J. Burrill, who was professor of botany at the University of Illinois from 1870 to 1912. From 1891 to 1894, and again in 1904, he was also acting-president of that institution. He was president of the American Microscopical Society during 1885 and 1886, and its secretary from 1886 to 1889. He served as a botanist in connection with the U.S. Agricultural Experiment Station from 1888 to 1912. At the time of his death Dr. Burrill had almost completed his seventy-seventh year.

Mr. H. Floy, who died recently in New York in his fiftieth year, had considerable repute as an electrical engineer in connection with hydraulic and high-tension long-distance transmission work. From 1892 to 1898 he was associated with the Westinghouse Company, and had afterwards practised independently as a consulting engineer. He was a member of the jury of awards at the St. Louis Exposition, and was the author of several works on electrical subjects, as well as of a large number of contributions to technical journals.

The death is announced of Mr. L. I. Blake, who was professor of physics and electrical engineering at the Rose Polytechnic Institute, Terre Haute, Indiana, from 1884 to 1887, and at the University of Kansas from 1887 to 1906. At various periods he was constructing electrical engineer on the U.S. Lighthouse Board, and chief engineer (afterwards consulting engineer) of the Submarine Signal Co., of Boston. He was also director and engineer of the Blake-Marscher Electric-Static Ore Separating Co., and was a member of several American scientific societies. He was in his sixty-second year at the time of his death.

Capt. R. J. Smith, of the Lancashire Fusiliers, who was killed in action on May 5, at the age of twenty-nine, was the eldest son of Mr. O. Smith, of Jigginstown House, Naas, Co. Kildare. He was educated at Mountjoy School, Dublin, was a graduate of Dublin University, and secured a science scholarship in the Royal College of Science for Ireland, receiving the associateship of that college in 1908. He taught in Kilkenny College in 1909, and then in the Technical Institute, Newry, Co. Down, from which he entered the works of the British Westinghouse Company, Manchester, as an engineer. He owed his rapid promotion in the Army to the technical knowledge which he was so fully able to apply.

Lieut. R. L. Valentine, of the 7th Batt. Royal Dublin Fusiliers, who died on April 30 from wounds received near Loos, was a scholar and an associate of the Royal College of Science for Ireland, where he devoted himself especially to natural history and geology. He was the youngest son of Mr. W. J. M. Valentine, of Dublin, and received his earlier education at the High School, Dublin. When the war

broke out, he was engaged on a research at Hook Point, Co. Wexford, leading to a correlation of the base of the Carboniferous strata with the recognised horizons of the Avonian series in south-western England. He had also just gained, by competition, a post as geologist on the Geological Survey of Ireland, and he completed the Civil Service qualifying examination when actually in military training. During his service he devised an important method for increasing the efficiency of the Lewis machine-gun. He was keen and untiring in any duty that he undertook, and would undoubtedly have made his mark among scientific men in Ireland. His loss is especially felt by those who had looked forward to his comradeship in public work.

THE death is announced of Dr. James William White, professor emeritus of surgery at the University of Pennsylvania. Born in 1850, he graduated in 1871, and then joined the scientific staff of the Hassler Expedition under Agassiz, returning in 1872 after visiting both coasts of South America and the Galapagos Archipelago. He then settled in Philadelphia, becoming first resident surgeon at the Eastern Penitentiary, and afterwards professor of genito-urinary surgery, professor of clinical surgery, John Rhea Barton professor of surgery, and, finally, emeritus professor of surgery of the University of Pennsylvania when appointed a trustee of the University. He was the author of many papers and works on surgery, and in former years was an athlete of many parts. On the occasion of its quatercentenary in 1906 the University of Aberdeen conferred on him the honorary degree of LL.D. When the war broke out Dr. White devoted himself with characteristic energy to the cause of the Allies, and published many articles in order to enlighten American public opinion on the origin of the outbreak. He was a well-known visitor to this country, where he formed many friendships.

THERE has been a poetic simplicity in the quiet life, just over, of Mr. John Griffiths, Welshman, mathematician, and college tutor, for many years past Senior Fellow of Jesus College, Oxford. Childhood in a farm-house at Llangendeirne, near Kidwelly; schooldays at Cowbridge; half a century of congenial study, research, and not too burdensome teaching in the walls of his college; ten years of repose in the village where he was born. His modesty was extreme, his shunning of company excessive. Happy with a few real friends always close, and with Kidwelly for the Tipperary of his heart, he wanted no outer circle of acquaintances. If he cherished any unsatisfied ambition, it was unexpressed. Fortunately he allowed himself to write—impulsively, nervously, cleverly, but too briefly to do himself justice. He produced a quite early volume on the geometry of the triangle, and some thirty or forty notes and papers for the London Mathematical Society and for journals. Some of these deal with geometry, others with elliptic functions. His pupils, even if many passed from his sight, were lastingly attached to him. Among them were H. W. Lloyd Tanner (deceased), Prof. W. J. Lewis, and the present registrar of the University of Oxford.

IT is reported from Amsterdam that Prof. Karl Schwarzschild, director of the Astrophysical Observatory at Potsdam, has died from illness contracted while on military service. In the early part of the war he was said to have been acting as meteorological expert in connection with aeronautics at Namur, but is now described as having been an officer in the artillery. Prof. Schwarzschild was born at Frankfort in 1873, and took his doctor's degree at Munich in 1896. He was appointed assistant at the Von Kuffner Observatory at Vienna in 1896, was *Privatdozent* at Munich from 1899 to 1901, and became professor of astronomy and director of the observatory at Göttingen in 1902. He succeeded Vogel as director of the great observatory at Potsdam in 1910. Prof. Schwarzschild's contributions to astronomy were very numerous and covered a wide range of subjects. His mathematical investigations of the pressure of sunlight, in relation to the dimensions of the particles acted upon, are well known in connection with theories of the solar corona and the constitution of comets. He gave much attention to stellar photometry, and developed important practical methods of observation in this connection; the use of a coarse grating on the object-glass of a telescope, which has yielded such valuable data for photographic magnitudes, was first adopted by him in 1895. He also attacked, with some success, the problem of applying the objective-prism to the determination of radial velocities. Prof. Schwarzschild was a notable contributor to the investigation of stellar motions and the structure of the universe. His name will be especially identified with the "ellipsoidal" hypothesis as an alternative to the hypothesis of two star streams, suggested by Kapteyn. He was elected an associate of the Royal Astronomical Society in 1909. By his death astronomy has lost an investigator of untiring industry and marked originality.

IN spite of the elaborate survey of the pagan tribes of the Malay Peninsula, by Messrs. Skeat and Blagden, much still remains to be done by local workers. In the Journal of the Federated Malay States Museum, vol. vi., part iv., for February last, Mr. J. H. N. Evans, in his account of the aboriginal tribes of Upper Perak, supplies much information interesting to anthropologists. It is generally admitted that the form of the round hut which survives for ritual purposes in Roman temples and Christian churches was originally conditioned by the form assumed in bending by elastic bamboos or branches. But it is curious to note that among most, if not all, of the aboriginal tribes of the peninsula the spells of the magician are performed within a magic circle; in some cases a round hut of leaves is erected within which the magician ensconces himself; in others merely a round frame with hangings is used. This points to a very primitive ritual use of the round hut. The article contains much other valuable information, and is illustrated by photographs of the ethnical types of the tribes visited by Mr. Evans.

THE sixth memoir issued by the South African Institute for Medical Research is a study of the "Trypanosomes of Sleeping Sickness," by Mr. G. P. Maynard, statistician and clinician to the institute. The author, who has applied Prof. Karl Pearson's method of resolving a compound distribution into two "normal" components to a number of length distributions of trypanosomes, adversely criticises several of the conclusions reached by the Sleeping Sickness Commission of the Royal Society. He holds that the published length distributions afford no valid argument as to the identity or otherwise of *T. brucei* and the trypanosome causing disease in man in Nyasaland. Several of Mr. Maynard's conclusions will not pass unchallenged, but his memoir is of great interest, and should be studied by all who wish to master the numerous and perplexing problems suggested by the facts at present known respecting the etiology and epidemiology of sleeping sickness.

THE *Museums Journal* for May contains an excellent and detailed account of the Wellcome Historical Medical Museum, originally formed for the benefit of

the seventeenth International Congress of Medicine, held in London in August, 1913. Thanks to the generosity of its founder, Mr. Henry S. Wellcome, the collections then brought together were rearranged and embodied as a permanent institution in 1914. "One of the chief objects of the museum," remarks Mr. C. J. Thompson, its curator, "is to stimulate among medical practitioners of to-day the study of the history of medicine, and thus to suggest fresh fields of research." Mr. Thompson has illustrated his article with some excellent photographs. Other items of interest in this number refer to the considerable extension of museum work in Germany. One new picture gallery and no fewer than sixteen war museums have been founded since hostilities began. This contrasts unfavourably with the efforts, in the name of "economy," which have been made to *close* museums in Great Britain.

MR. H. F. WITHERBY makes his fourth series of records on the moulting and sequences of plumage in the British Passeres in the May number of *British Birds*. This is, of its kind, a most admirable piece of work, and should earn the gratitude of all ornithologists. In the course of the present article he gives a most interesting example at one and the same time of the recapitulation theory and the disappearance of structures by degeneration, or "evolution by loss," as Prof. Bateson has it. To wit, he shows that in the larks the outermost primary in the first, teleoptyle, plumage is almost twice as large as that produced in the next and all subsequent moults, this outermost quill having, for some reason, become superfluous. In the same issue Miss E. L. Turner makes some noteworthy observations on the breeding habits of the sheldrake. She adds to our knowledge of their courtship habits, as well as to that of their post-nuptial behaviour. At one point on Holy Island, the scene of her studies, she found sheldrakes breeding in considerable numbers, and here, while the females were incubating, the males indulged in "regular organised games, and were more or less gregarious." On other parts of the island they were breeding in isolated pairs, and in these cases the males would "sit about in solitary grandeur."

THE results of a botanical exploration of Lower California are given in a useful paper by Mr. E. A. Goldman in Contributions from the United States National Herbarium, vol. xvi., part 14. The author and Mr. Nelson spent nearly a year in traversing this interesting region, which floristically is separable into two main divisions, one identical with that of southern California, the other, in the south, of a more austral type, derived from or related to that of the adjacent Mexican mainland. The higher mountains are crowned by oak and pine forests, and in the more arid parts monstrous forms of plant-life have been developed, which give the landscape an aspect of unreality. Several remarkable genera are peculiar to the peninsula. As a result of the expedition twenty-two new species were discovered. Good plates are given of the more interesting plants, and among those especially noteworthy from the dry regions are *Pachycormus discolor* (Anacardiaceæ), a monotypic genus confined to the peninsula, *Fouquieria peninsularis* and *Idria columnaris* (Fouquieriaceæ), reminding one of the extraordinary desert forms of S.W. Madagascar, and *Ibervillea sonorae* (Cucurbibaceæ), with a large woody base.

THE term aerography is a new one, and probably makes its first appearance in an article by Prof. Alexander McAdie, of Harvard University, in the *Geographical Review* for April (vol. i., No. 4). It is suggested to restrict it to a description of the atmosphere at different levels, or, as the author puts it, a description of the structure of the atmosphere. Prof. McAdie pleads that the base-level of the sea, familiar in meteorology, must be discarded in aerography, and replaced by the base of the stratosphere. In this he agrees with the opinion of Sir Napier Shaw. The paper is a short one and much condensed, but it contains some useful suggestions, such as a plea for maps showing the atmospheric conditions at various levels, and for measurements of the vertical flow of air and its cartographical representation. The construction of charts of air structure would have a practical importance to aviators.

THE provision of a standard scale of seismic intensity is a problem which has for many years engaged the attention of seismologists. In his presidential address last year to the Seismological Society of America (Bulletin, vol. v., 1915, p. 123), Prof. A. McAdie suggested that the well-known Rossi-Forel scale had outlived its usefulness, and that it should be replaced by a dynamical scale of intensity. He offered one on the lines of the Omori and Cancani scales, but consisting of ten degrees, of which the lowest corresponds to an acceleration of 1–10 mm. per sec. per sec., and the highest to one of 5000–10,000 mm. per sec. per sec. Prof. McAdie's suggestion is the subject of an interesting discussion in the last bulletin of the society (pp. 177–89). Though the general opinion seemed to be that some absolute scale would in time be adopted, the difficulty of determining the intensity accurately from seismographic records is noticed, and also, if it were otherwise, the impossibility of providing the instruments in sufficient number. The wide variations of intensity within a limited area, such as Prof. Milne showed to exist in his seismic survey of Tokyo, might also have been mentioned as militating in favour of the Rossi-Forel or a similar scale.

SCIENTIFIC PAPER No. 264 of the U.S. Bureau of Standards, by Messrs. Middlekauff and Skogland, deals with the photometry of gas-filled tungsten incandescent lamps. It is found that when the volts on such a lamp are kept constant the current transmitted and the candle-power are higher when the tip is up than when down. If the lamp is rotated about a vertical axis the current increases, reaches a maximum, decreases to its initial value at a speed depending on the shape and number of loops of the filament, and at higher speeds decreases still further. The changes are greater with the tip up than with it down, and the candle-power in each case changes in the opposite direction to the current. The authors have succeeded in tracing these curious effects to the convection currents in the gas in the lamp. They suggest that in the practical tests of such lamps the speed of rotation should be so chosen that both current and candle-power have the normal values. For lamps of similar construction this speed is fixed, and is in many cases 30 or 40 revolutions per minute.

IN a paper read before the Society of Chemical Industry on April 3, Prof. H. E. Armstrong urged the formation of an Imperial Society of Scientific and Industrial Chemistry, similar in character to the Royal Medical and Chirurgical Society, which in 1907 united the activities of seventeen previously existent societies of medical men. Prof. Armstrong enumerates more than a dozen societies, now entirely independent, which could be made constituent societies of such an Imperial Union. He points out the necessity of co-operation in order to ensure the progress of chemical science and chemical industry, both terms being used in their

broadest meaning, lays stress on the evil arising from the ever-increasing specialisation amongst chemists, and emphasises the present waste of effort involved in the publication of so many overlapping journals. Mr. C. T. Kingzett, in an article in the *Chemical Trade Journal* for April 8, develops the same theme. He advocates the establishment of a "real" Institute of Chemistry, to comprise the present Institute, the Chemical Society, Society of Chemical Industry, etc. He also indicates the waste of time, energy, and money involved in the present independent status of the various chemical associations, and remarks on the narrowing influence resulting from the lack of mutual association between them.

THE April part of *Science Progress* contains several articles of interest. Sir Ronald Ross contributes a further instalment of his researches into the theory of equations; Dr. Johnstone, under the slightly misleading title, "The Mathematical Theory of Organic Variability," provides an elementary account of the genesis of Prof. Pearson's family of frequency curves; and Mr. C. Mansell Moullin discusses the natural history of tumours. Other contributors are Prof. Fraser Harris and Mr. Joseph Offord. A valuable feature is a sketch of recent progress in various departments of science under the heading "Recent Advances in Science." Few readers will dispute the justice of the bitter strictures which bulk largely in the editorial notes upon our national neglect of science.

OUR ASTRONOMICAL COLUMN.

COMET OR NEBULOUS MINOR PLANET?—At the Königstuhl Observatory a photograph taken on April 3 showed what seemed to be a new minor planet, which received the designation 1916 ZK. Its daily motion was −0·6m. and +3′, whilst its magnitude was 13·0 (*Astronomische Nachrichten*, 4841). Three days later, on another photograph, it presented a nebulous appearance. This was more strongly developed by April 27 (*Astronomische Nachrichten*, 4843). Dr. Max Wolf's observations have been confirmed at the Babelsberg Observatory (*Astronomische Nachrichten*, 4843). On April 30 the nebulosity involved a stellar nucleus. This remarkable body evidently bears a likeness to Neujmin's comet 1913*c*, which resembled a minor planet when first discovered, but a few days later developed a weak cometic chevelure; and the latest observations indicate that it is really a new comet. The position of the object on discovery was:—April 3, R.A. 12h. 52·9m., declination +0° 11′; on April 30, 12h. 58·9m., +2° 39·6′. The daily motion on April 27 was −0·5m. and +5′ and the magnitude was 13·3.

THE POLE EFFECT IN THE CALCIUM ARC.—Important quantitative details concerning the pole effect in the arc spectrum of calcium ($\lambda\lambda$ 3000–4200) are given by Messrs. Gale and Whitney in the *Astrophysical Journal* (vol. xliii., No. 2). The measures of spectra from a horizontal arc 4 mm. long, carrying 4 amperes on a 110-volt circuit, with calcium electrodes 7 to 10 mm. in diameter, indicate a progressive change of from 0·01 to 0·02 tenth metres between positive and negative pole correlated with the series classification of the lines. Although the pole effect seems to be independent of the vapour density of the radiating ions, negativing the suggestion that it is due to the internal pressure of the arc, yet it shows a parallel relationship with the pressure shift. Very significant is the reversal of the gradients of both intensity and pole effect observed when the current is reversed in an arc having one pole of silver, the other being of calcium. The authors suggest that the pole effect depends on the amplitude of vibration of the electrons.

THE ROTATION OF NEBULÆ.—Some additional data concerning rotating nebulæ have been obtained at the Lick Observatory by W. W. Campbell and J. H. Moore (Bulletin No. 278). In spectrograms of the complicated planetary nebula in Aquarius, N.G.C. 7009, taken with the slit set on the major axis of the image, the maximum displacements of the two chief nebular lines indicate a rotational velocity of 6 kilometres per second at a distance of 9 seconds of arc from the nucleus; the inclination of the lines gave a similar result. In the case of N.G.C. 6543, the historic planetary in Draco, the central portion of the nebula, about 6·7″ diameter, is rotating about an axis in P.A. 130°, with a velocity of 5 km./sec. In both cases the nebular lines, in addition to the general inclination, are also somewhat contorted, indicating lower velocities in the outer regions. These observations lead to some very interesting conclusions regarding the probable masses of the nebulæ. Corresponding to an inferior limit of distance of 100 light-years, their respective masses would be 11·3 and 2·8 times solar, whilst the mean density of N.G.C. 7009 would be of the order of 1×10^{-6} times that of hydrogen at 0° C. and 1 mm. of mercury. The density of N.G.C. 6543 appears to be about five times as great. It is considered that the evidence indicates that planetary nebulæ must be regarded as three-dimensional objects. In this connection it was suggested many years ago that a bright ellipsoidal shell viewed from a distance would present the appearance of a ring nebula.

NATIONAL DEFENCE AND DEVELOPMENT IN THE UNITED STATES.

THE proceedings of the American Association for the Advancement of Science at its annual meeting held at Columbus at the end of last year were characterised by a large number of papers read before the section devoted to Social and Economic Science on various aspects of national defence and development, a reprint of which appears to the number of eleven articles in the *Scientific Monthly* of New York for the month of April.

The events of the European war seem to have awakened in the minds of the economists of the association dire anticipations of similar devastating results to the United States so soon as the war is concluded, and they have hastened to recommend the most extraordinary provision and a vast expenditure in order to place the nation in a condition of complete defence by the establishment of a standing army of from half a million to a million men, of a great reserve, and of a navy at least equal to that of the greatest European naval Power. The doctrine of "preparedness" seems to have taken firm root amongst them, together with the dictum quoted from Washington, "To be prepared for war is the most effective means of promoting peace." The success of Germany in the early days of the war, and the efficiency of her military arrangements, have evidently made a deep impression on the American mind. It is pointed out, for example, that England spent 53½ years of the nineteenth century in war, and France not much less, whilst Prussia spent but thirteen years, the result of her extraordinary preparedness. As a result of her efficiency, she "quickly finished her fights and got back to work. The wars of the other nations were long drawn out, due, as we know, to the necessity of their learning and preparing to fight after their wars had begun."

It is claimed that a condition of perpetual and

universal peace can only be attained when the preponderance of military power has passed into the hands of the pacific peoples. It is, in short, a world in arms that is desiderated. It is argued that as the independence of the States was achieved by an appeal to arms, so its future immunity can only be secured by like means. If force was necessary in the infancy of the nation it is the more essential now, having regard to the command men have secured over the powers of nature. Apprehension is expressed at the eventual attitude of Great Britain as the greatest naval Power, but really with but little justification, since a war with the United States on the part of Great Britain, however much provoked by unscrupulous commercial enterprise or methods, is entirely unthinkable. Rightly considered, the position of the United States is unassailable by any European Power, and having regard to its immense natural resources, to its great and increasing population, to its vast potential and acquired wealth, it occupies a unique position in the civilised world as a preponderating, moderating influence for good in the comity of nations. It is a great factor for the future well-being of mankind that so vast an extent of territory should be under one flag and subject to one polity, and that its people should be mainly concerned with the internal development of its great possibilities.

Science in all its varied aspects has an immense field in the United States, whether in its application to the development of agriculture (the country is now the greatest grain-producing area of the globe, with the lowest yield per acre), to the electrical utilisation of its abundant water-power, to the exploitation of its vast and varied mineral deposits, to the creation of a great mercantile marine, or to the applications of scientific discovery to the production of synthetic products of all kinds. The example of Germany may fitly be followed here. Much has undoubtedly been done in the establishment since 1861 in all the States of well-equipped agricultural colleges and by the extraordinary munificence of her wealthy citizens in founding and endowing colleges and universities. The example of Germany has taught the people much, and it has been accentuated by the efficiency displayed in the course of the war.

The best minds in the States are deeply engaged in the consideration of the factors which will in their application make for the betterment of all classes of the people, not the least of which is education, widespread and sound in all its grades, in which science will play its effective and humanising part, not as a destructive, but as an ameliorating agency.

The vast expenditure it is recommended to incur upon "preparedness" for war would, if devoted to measures for the better education and amelioration of the conditions of life of the people, be a surer guarantee of peace than any warlike preparations, however effective, with the added advantage that the best interests and the highest happiness of the nation would be secured and advanced.

THE PEAT INDUSTRIES OF WISCONSIN.[1]

IN a report recently published upon the peat resources of Wisconsin, Mr. F. W. Huels describes the attempts which have been made to utilise peat in that State. In one of these, the Lamartine Peat, Light and Power Company manufactured machine-turf on a moor near Fond du Lac during the years 1905 and 1906. The peat, which was raised from the bog by a dredger, was macerated and moulded in a modified form of pug-mill. The air-dried turf was sold for twenty-five shillings per ton at Fond du Lac—the nearest town—which was seven miles from the factory. As the fuel contained about 17 per cent. of ash, it is obvious that, at the price, it could not compete with coal. The factory was closed in 1906 and has not since been reopened.

The Whitewater Peat Company in 1902, at a bog more favourably situated with regard to transport facilities than that of Fond du Lac, manufactured press-turf for a short time. The estimated cost of the product was eight shillings per ton. With a view of avoiding the necessity of waiting five weeks for the air-drying of the peat, attempts to introduce artificial drying were made, and, as might have been foreseen, the failure of the company followed.

As a result of a detailed examination of the whole question, Mr. Huels concludes that little use will be made of the Wisconsin peat deposits until at some period in the distant future fuel has become scarce and expensive. This conclusion, although justifiable in the case of peat, like that of Wisconsin, with high ash content, does not apply to peat of low ash content, such as that found on many of the European moors, and, indeed, it is even possible that the further prosecution of the experiments on the manufacture of power-gas from peat, carried out at the University of Wisconsin, may lead him to a reconsideration of his decision.

There is now no doubt that, in districts where peat is plentiful and coal is dear, peat of low ash content can be economically utilised for the manufacture of producer-gas or of semi-water gas. Thus the town of Skabersjo, in Sweden, for the past eleven years has been supplied with electricity for illumination and power purposes by a high-voltage current transmitted from a bog three miles from the town, where it is generated in dynamos driven by engines supplied with semi-water gas made from machine-turf in a suction power-gas producer of the Koerting type. A horse-power hour requires about $4\frac{1}{2}$ lb. of air-dried turf, which at the power station costs less than four shillings per ton. Similarly at Visby, turf costing about five shillings per ton is converted into semi-water gas and employed to drive the machinery of a cement works.

Apart from its use as moss-litter, peat can be economically employed as a fuel in the immediate neighbourhood of a moor, or on a larger scale it can be converted with advantage into producer-gas, the latter serving as fuel for the manufacture of substances such as glass, or into semi-water gas for power purposes, like that for which it is utilised at Visby.

[1] Wisconsin Geological and Natural History Survey. Bulletin No. xlv Economic Series No. 20. The Peat Resources of Wisconsin. By F. W. Huels. Pp. xvii+274. (Madison, Wis.: Published by the State, 1915.)

THE OXIDATION OF DRYING-OILS.

MUCH attention is now being paid to the scientific aspects of the phenomenon of "drying" whereby, for instance, boiled linseed oil on exposure to the air is converted by oxidation into a hard varnish-like product. The experiments by which Dr. R. S. Morrell was able to isolate a crystalline component from a drying-oil (Trans. Chem. Soc., 1912, vol. ci., 2082), namely, by the action of light upon Hankow "Chinese wood oil," have already been noted in these columns. A further advance is recorded in a paper by Dr. A. H. Salway, which has recently appeared in the Chemical Society's Journal (vol. cix., pp. 138–45). This investigator has oxidised linseed oil by shaking it with oxygen at 100°, and trapping the volatile products in a wash-bottle containing water. Not only was the odour of acrolein, $CH_2:CH\cdot CHO$, observed, but the solution showed the chemical reactions of an aldehyde, and on shaking with silver oxide gave a sufficient quantity of silver acrylate, $CH_2:CH\cdot CO\cdot OAg$,

for identification by estimation of the silver contained in it.

Since acrolein is easily produced by the dehydration of glycerine, it has usually been assumed, when the odour of this compound has been detected, that it was derived from the glycerine of the glycerides which constitute the drying-oil. This assumption has been disproved in the present instance, since acrolein was also obtained by oxidising in a similar manner the free fatty acids obtained by hydrolysing the oil, as well as by oxidising the linolenic acid which is the chief product of this hydrolysis. No acrolein was formed in the oxidation of oleic acid, and it is doubtful if linoleic acid would give any acrolein if it could be obtained quite free from linolenic acid.

In order to explain these observations, it is suggested that linolenic acid contains three copulated double-bonds, of which the two outer ones only would unite with oxygen to form an oxygenide, and then rupture with formation of pairs of aldehydic groups, thus—

$$(1) \quad -CH{=}CH-CH{=}CH-CH{=}CH-$$

$$(2) \quad \begin{array}{cccccccccccc} -CH & - & CH & - & CH{=}CH & - & CH & - & CH- \\ | & & | & & & & | & & | \\ O & - & O & & & & O & - & O \end{array}$$

$$(3) \quad -CHO \mid \underbrace{CHO-CH{=}CH-CHO}_{\text{fumaraldehyde}} \mid CHO-$$

$$(4) \quad CO+\underbrace{CH_2{=}CH{\cdot}CHO}_{\text{acrolein}} \qquad (5)\ CHO{\cdot}CHO+CHO.CHO.$$

The hexatriene group would thus give rise to fumaraldehyde, from which acrolein could be produced by removal of carbon monoxide (or by oxidation with removal of carbon dioxide), whilst oxidation of the double-bond would give rise to glyoxal, $CHO{\cdot}CHO$. It is suggested that this formation of aldehydes by oxidation is an essential feature of the process of drying, and that the varnish-like product, to which the name linoxyn has been given, is essentially a mixture of polymerised aldehydes, including polymerisation products of acrolein and glyoxal.

It is an encouraging sign of the times that investigations such as these should be undertaken by important commercial companies, as a normal part of the work of their research laboratories; no better omen could be discovered for the stability of British chemical industries in face of the severe competition which may be anticipated in the near future.

T. M. L.

INDUSTRIAL RESEARCH IN THE UNITED STATES.[1]

WHILE research is receiving increasing recognition as an essential factor in industrial work, little attention has been given to the manner in which scientific resources in this country can best be directed to meet national industrial needs. A description of the manner in which the United States is dealing with this matter may be useful in throwing some light on our problem, and incidentally the evidence of the progress in that country of industrial research may be inspiring to English manufacturers, who are somewhat sceptical as to the value of science in industry.

The term "industrial research" is often very loosely applied, and it is necessary first of all to define what it really comprises. One may consider it to be focussed in a simple fundamental principle that an industry depends for progress on a continual influx of new knowledge, and it may be conceived that industrial research embraces all means whereby this new knowledge having application in industry can be obtained, whether it is from the accumulated experience of individual workers, or from the efforts of trained investigators directing their efforts to the solution of manufacturing problems impeding the progress of industry, requisitioning where necessary the aid of contemporary science; or whether from new discoveries resulting from investigations in pure science which ultimately find their application in industry.

Industrial research in the United States is mainly accomplished by individual firms, although a good deal is done in the universities and national institutions. With certain exceptions, noted later, the greater part of the university work, however, is directed to pure science investigations having no immediate commercial object.

As regards the work of individual firms, during the past ten years there have been very considerable sums spent by the leading manufacturing corporations to provide facilities for scientific investigation. Annual expenditures for this purpose of 25,000*l.*, 50,000*l.*, and even 100,000*l.* are not uncommon. The leading firms possessing private research laboratories include the General Electric Co., Schenectady; Westinghouse Electrical and Manufacturing Co., East Pittsburg; Eastman Kodak Co., Rochester, New York, this firm representing the manufacture of photographic chemicals and apparatus; the Du Pont Powder Co.; the American Rolling Mill Co., producing sheet iron and steel; the National Electric Lamp Association, representing a large number of electric lamp manufacturers; the General Chemical Co.; General Bakelite Co.; United States Steel Corporation; the Edison Laboratories; Pennsylvania Railway Co., which deals with all kinds of materials and investigations pertaining to railway requirements; and many others.

Among the important features of the work of many of these laboratories is the equipment of full-scale manufacturing plant, which enables discoveries in the laboratory to be fully tried out and manufacturing methods perfected, relieving the manufacturing departments from the hampering effects of new developments. Many of the laboratories also are equipped for the manufacture on a commercial scale of some of the commodities developed from their discoveries which are not of a character adapted to production in the manufacturing departments. The laboratory production in such cases is continued until it reaches such dimensions as justify the starting of a separate works. There is a growing tendency in many of the research laboratories to devote more and more attention to investigations in pure science having no immediate commercial object in view, with an appreciation of the fact that almost invariably such investigations result in industrial application, sometimes bringing about the development of entirely new industries. Prominent examples of this kind are represented by the work of the General Electric Co.'s laboratory at Schenectady and the National Electric Lamp Association. In connection with such work, a very broad-minded policy is shown by the publication of the scientific investigations carried out.

It is also noteworthy that these research laboratories serve as very effective advertising means by inspiring confidence in the minds of purchasers as a result of such visible evidence of scientific working.

There appears to be no doubt that these laboratories have proved financially successful, not only in that they afford the greatest possible assistance to the works with which they are connected in solving manufacturing troubles, developing new materials, methods, tools, and making discoveries which result in new industrial developments, but also in the direct manufacture and

[1] Synopsis of an address delivered before the Engineers' Club, Manchester, at the Municipal School of Technology, on April 4, by A. P. M. Fleming.

sale in many cases of valuable products straight from the laboratory.

A great deal of the research work of the universities is devoted to purely scientific investigations arising in connection with the preparation of degree theses by students, and from work done by the staff in their spare time. Apart from this, however, many investigations directed to the solution of particular manufacturing problems are carried out for private firms, and in a number of cases experiment stations have been arranged, the staff of which devote all their time, or at least most of it, to research investigations. Prominent examples of such experiment stations are those of the Illinois State University, Massachusetts Institute of Technology (now incorporated with the School of Engineering, Harvard University), Ohio State University (the experiment station of which has recently been inaugurated), and the Universities of Iowa, Kansas, etc.

In connection with Columbia University, it is proposed to erect a laboratory specifically devoted to research, the cost of which it is estimated will be of the order of 130,000*l.* for buildings and equipment, and it is expected that an endowment fund for extension and maintenance of from 400,000*l.* to 1,000,000*l.* will be required. This proposal appears to be inspired to some extent by the success of the research laboratories associated with the large industrial corporations already referred to, and it is realised that there are many smaller manufacturers who are unable to support individually the burden of such laboratories who would be glad to avail themselves of the opportunities which this university research laboratory would afford.

An important feature of the proposal is the intention of devoting means to the collection of all possible information bearing on the industrial problems that are likely to be considered.

The most striking feature of the research work of the universities is this provision of research facilities and the use of a staff of highly trained scientific men who can devote their whole efforts to scientific investigation without the handicap of a great deal of teaching work, and as well as of financial anxiety. It is also noticeable that increasing numbers of young men who have taken their bachelor's degree proceed to a doctor's degree, possibly on account of the opportunities for employment now presented by the increasing number of research laboratories for men of the highest scientific training.

While the students themselves do not generally participate in the investigational work of the experiment stations, this work cannot fail to be of considerable inspirational value to them.

The researches of the experiment stations are freely published, and in connection with the Illinois State University more than eighty important bulletins have already been issued, some of them comprising the most authoritative work on the subjects with which they deal.

The work of the Mellon Institute of Industrial Research, associated with the University of Pittsburg, has often been described in the English Press. Manufacturers are invited to bring their problems to the director of the institute, and to provide fellowships to support the men who will carry out their investigations. Usually these fellowships are tenable for a period of one or more years, and may be of the value of from 100*l.* to 400*l.* or 500*l.*, according to the nature of the investigation. The director then selects suitable men from the universities or other institutions, who proceed to the manufacturer's works, study the problem under practical conditions, and then carry out the investigational work in the laboratories provided by the institute, under the supervision of a permanent scientific staff. Some seventy-five researches have already been carried out during the past four years, including such subjects as copper leaching, cement manufacture, timber preservation, smoke prevention, glass production, bread-making, paper manufacturing, etc.

Important features of the work of the institute comprise the educative influence it has on the manufacturers in focussing their attention on the possibilities of industrial research, and the fact that many of the young men who have successfully carried out researches have been absorbed into the industry with which they were temporarily associated, and in this way become powerful advocates for industrial research. To a limited extent this process tends to the permeation of industry with young men having keen appreciation of the application of science in industry.

Of the national institutions, the most important is that of the Bureau of Standards, which at present does a great deal of investigational work for the Government departments, and is prepared to carry out researches where it can be shown that these are likely to benefit an appreciable section of the public, in which case it is done at the public expense. Already in this connection much valuable work has been done in such subjects as the manufacture of refrigerating machinery, paper-making, investigation of alloys, etc.

A series of publications is issued by the Bureau of Standards comprising popular and technological bulletins, and bulletins recording the results of scientific investigations.

The Department of Agriculture is of some interest in that it carries on a scheme of investigational work on national lines. Connected with it are some hundreds of experiment stations in different parts of the States, which deal with experimental work relating to the growth of crops, including fertilisers, pests, etc., cattle-breeding, including the treatment of various diseases. Bulletins are issued to the agricultural communities, both in popular and scientific form, and the organisation provides for lectures dealing with special features of interest to different sections of the agricultural community.

While there is as yet no national plan of industrial research, there are tendencies in that direction, some of which are directed to linking up the efforts of the universities, the extension of the experiment station scheme to a number of universities and colleges, and the co-ordination of the work of some of the existing laboratories connected with industrial concerns. In this connection there is always the evidence of the successful working of the Department of Agriculture to serve as an inspiration to those who desire to see national scientific facilities made applicable to manufacturing interests.

The work done in the United States is of considerable value in enabling us to shape our own schemes with reference to research, and although this country is considerably behind in the development of such schemes, considerable advantage accrues in being able to make use of the experience the States have already gained. Of that experience full use should be made.

The distinguishing feature of work done in America is that it is mainly in the hands of private companies, and is carried out in order that one company may compete more effectively with another. The development of the internal resources of the country has occupied most attention, and little work has been done with a view to encouraging export trade. In this country our export trade is of the first importance, and it is here that the country feels the pinch of German competition. The opportunity, therefore, arises to take the greatest possible advantage of laxity in the past and at the same time to take steps to conserve our overseas trade.

This can only effectively be done by co-operating

and pooling our scientific resources, which have hitherto lacked organisation. Doubtless many manufacturers will in future provide themselves with small laboratories where manufacturing difficulties peculiar to their own works can be solved, but the big advance in the future can only come by concentrating advanced research in a large central institution. The materials, tools, and processes which are common to any industry would be considered in such an institution, and efforts devoted to improving them for the common benefit of the industry. Processes which are the monopoly of any individual firm would have to be left out of such a scheme. Differences of factory organisation and management and methods of distribution would still enable manufacturers to compete among each other, but the whole industry would be lifted to a higher plane through discoveries arising from work done at a research institution, which would enable foreign competition to be met most successfully.

Such an institution would comprise a laboratory for each of the great industries—engineering, shipbuilding, soap-making, dyeing, rubber, paper, metal, and textile manufacture, mining, etc.—housed in a large central building. Much of the work done would be along lines of pure science investigation, so as to ensure priority of new applications in industry. Patents would be taken out by the Board of Control, and manufacturers in this country or the Colonies licensed to manufacture at a nominal charge.

The advantages of such a scheme over a system of isolated laboratories in different centres are as follows:—

(1) Work would be done without the overlapping which inevitably occurs among a number of different institutions, and results in great lack of economy.

(2) Administrative expenses would be reduced to a minimum.

(3) Since one research frequently leads to others quite unsuspected originally, if all the work were done in one centre fresh investigations could be carried out with the least loss of time and the greatest possible efficiency.

(4) The problem of collecting information on problems considered would be reduced to a minimum by housing copies of all matter required in one library.

(5) The problem of distribution of information would in the same way give as little trouble as possible if handled by a bureau attached to the institution.

(6) It is of the greatest possible value to have a number of men engaged in research problems housed in one building where opportunities arise for frequent meetings. The stimulation arising from intercourse in this way can scarcely be over-estimated. This would be very largely lost in a system of isolated laboratories.

The advantages the above scheme presents over any proposal to distribute the research work among the universities are equally obvious. The universities are now mainly teaching centres, and the importance of the research work done by the students lies mainly in its educational value. Lecturers and professors are generally too much occupied with teaching to devote time continuously to research, and the complexity of modern research demands, above all things, continuity of application. If the universities adopt the plan of having two separate staffs, one for teaching and the other for research, then there would be an obvious gain in transferring the research workers to the central institution, where the best possible equipment and facilities would be obtainable. At present good research workers at the universities are often spoiled by having to undertake teaching, while really capable lecturers seldom make first-class research men.

On the other hand, the existing facilities of the universities comprising equipment and staff could be utilised as an auxiliary to the central institution for dealing with those problems for which their scientific apparatus and experience are best suited. In this way the whole of the scientific resources of the country could be co-ordinated and utilised in the national industrial interests.

British people seem to possess a certain industrial genius which assured them priority in the industrial world in the past, and the records of her inventors and discoverers lead to the belief that what has happened in the past may, with suitable organisation, be repeated in future.

In view of the fact that industrial research can be made to pay for itself, it would be an excellent investment if manufacturers in this country would devote the necessary percentage of the gross profits arising from industrial processes to equip and maintain a research laboratory planned on a comprehensive scale.

A critical survey of the work already accomplished in the States affords evidence in favour of the success of such a national attempt at industrial research, and ultimately such a scheme might be extended to embrace, not only the interests of this country, but also to link up the efforts made in our overseas Dominions, such as those of the recently established Institute of Science and Industry for the Commonwealth of Australia.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At the forthcoming annual conference of the Association of Education Committees a demand is to be made for the appointment of a Royal Commission to inquire into and consider the whole question of the organisation of our educational system and its adaptation to the new national needs which will arise after the war. The association will urge that there should be no delay in the appointment of such a Commission, and that the necessary inquiries should commence forthwith, so that the coming of peace may find us in possession of the facts as to the directions in which modifications and developments are desirable. To provide a complete and satisfactory system which will ensure the best education for all students up to the limit of their capabilities will of necessity be a costly undertaking, though, from the national point of view, it will be a highly remunerative investment. It is the duty of all who influence public opinion to insist upon this national need, and to explain that recent reductions in educational expenditure by local authorities is a mistaken and unwise economy.

In a recent Convocation address by Dr. Ewing, the Vice-Chancellor of the Punjab University, attention was directed to the necessity that urgently exists of broadening the basis of higher education in India. Dr. Ewing said:—"I have dreamed of the establishment here of a College of Commerce as an integral part of our activities; of the foundation of industrial fellowships for the investigation of specific problems connected with industry." With this as a text, the *Pioneer Mail* of March 25 includes a convincing article pointing out the enormous numbers of graduates which are being turned out by Indian universities, the great majority of whom are only fitted by their training for various posts in Government employ and for the practice of the law. These two professions are, and have been for years, largely overcrowded. Relatively few graduates take up engineering or medicine, and still fewer take up commerce, trade, or agriculture. It is pointed out that many of these highly educated Indians, trained largely on a literary basis, must of

necessity remain unemployed, and the *Pioneer Mail* remarks that "an educated and unemployable residuum, ever growing bigger and bigger, may develop into a very real danger." The efforts which were made during Lord Curzon's Viceroyalty, and have been continued since, to make education in India more practical appear to have had rather slow growth, and it is to be hoped that further efforts will be made in this direction, as indicated by Dr. Ewing in his Convocation address.

A copy of the calendar for 1915–16 of the University of Hongkong has been received. The historical sketch which the calendar contains shows that the idea of establishing a University in Hongkong was first suggested in 1905, but it was two years later before the matter took definite shape. In 1907 Mr. H. N. Mody offered to erect the necessary buildings at a cost of 30,000*l.*, and to give 6000*l.* towards an endowment fund. In 1908 it was proposed to accept this offer, and to erect a building in which the existing Hongkong College of Medicine and a Technical Institute should be located, and to incorporate a University under Ordinance. The scheme was somewhat modified in view of its cost, and Mr. Mody undertook to erect the buildings whatever the expense, but if this exceeded 36,000*l.* not to be responsible for any endowment or for furnishing. Before the end of 1909 the Endowment and Equipment Fund had reached 255,833*l.* The University was incorporated, and came into existence on March 30, 1911. By March, 1912, the main building was practically completed, and the University formally opened. Sir Charles Eliot, Vice-Chancellor of the University of Sheffield, was appointed principal and vice-chancellor, and arrived in Hongkong in June, 1912. The cost of the buildings and the preparation of the ground was 69,000*l.*; the value of the sites given by the Government is estimated at 35,260*l.*; the cost of the anatomical school is estimated at about 6000*l.*, most of which was raised separately by the Chinese. By the founding of the University a service has been rendered already to all the schools of South China, and the success of the University seems assured. Its interests are represented in London by a consulting committee, many members of which have been nominated by scientific and technical bodies.

The ninth report of the Executive Committee of the Fund for Advanced University Education and Research at University College, London, has just been issued. Since the issue of the previous report the committee has been reorganised under the presidency of H.R.H. Prince Arthur of Connaught. The attention of the committee during the period under review (1914–15) has been chiefly directed to the completion of the new chemistry building. The work accomplished was the completion of the building itself and installation of the fixed fittings, such as benches and cupboards, and gas and water supplies. This enabled the transference of the department from its old quarters to take place during the summer vacation, 1915. The apparatus and chemicals now being used in the new department are the old and antiquated stock from the old building, and are hopelessly inadequate. The completion of the scheme for an up-to-date laboratory falls into two main sections. The first is the technical laboratory and the physical chemistry laboratories for teaching and research, to the completion of which the chemical staff attaches the greatest importance. These cannot be finished or equipped until the money, estimated at 10,000*l.*, is available. It may be pointed out that Germany's success in chemical industry has been largely due to the application of the methods and principles of physical chemistry to technical problems, and that for the study of this branch of the subject laboratories have hitherto offered few facilities. For the equipment of the rest of the building a sum of 4000*l.* is required, and a further sum of 6000*l.* is considered necessary for the development of research during the next few years. Towards the estimated total cost of 20,000*l.* several donations have been promised; of these the most important is one of 5000*l.* by Sir Ralph C. Forster, Bart., provided that the balance of 15,000*l.* is subscribed promptly. Anyone interested in this development of opportunities for study in this important subject can obtain further information on application to the Provost, or to the Professors of Chemistry, at University College.

A noteworthy article by M. Paul Rivals, professor of industrial chemistry in the faculty of science at Marseilles, bearing upon the organisation of higher technical instruction in the universities of France appears in the *Revue Générale des Sciences* for March 30. It discusses a proposal submitted by M. le Sénateur Goy for the establishment by law of new faculties of applied science, for the conversion of certain faculties of science into faculties of applied science, and for the transfer of the technical institutions now under the jurisdiction of the faculties of science to the control of the new faculties, the staffs of which would be appointed irrespective of academic diplomas and because of their technical attainments, and the students would be recruited from licentiates in science and from those possessing certificates of higher studies. The faculties would be empowered in certain cases to confer the degree of Doctor of Applied Science. The necessity for the reinforcement and enlargement of the means of higher technical instruction in France is admitted, and that the universities should co-operate in the work, but the proposed measures are not the best, says Prof. Rivals, to achieve this purpose. In the first place there should be established higher technical institutions fully recognised by the universities, and in the second place they should be autonomous institutions, the sole aim of which should be the training of the technician, whose ultimate worth would be established by his achievements in the workshop rather than by his researches in the laboratory. His object is not to become a *savant*, but to be a thoroughly sound, well-trained, and practical technician. There is an essential difference between pure science and scientific teaching, and technology and the training of the technician. They cannot be run in the same mould; nevertheless, there should be the closest relation between them, and they should equally enjoy the protection and encouragement of the university of which they form part. The director of the technical institution will be a technician who, with a mind sufficiently wide and cultivated, will be able and alert to utilise and co-ordinate the enormous and unsuspected resources which lurk in the least of the faculties of science, and yet able, because he is an acknowledged master in his own sphere, to inspire in the students the fullest confidence.

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 18.—Sir J. J. Thomson, president, in the chair.—Hon. R. J. **Strutt**: An active modification of nitrogen. (1) The production of active nitrogen in various regions of the steady discharge has been studied. It is greatest near the kathode, falls off to a minimum in the Faraday dark space, and increases again in the positive column to a value which is constant along that column, but less than that at the kathode. (2) With a given value of the current,

much more active nitrogen is obtained from the positive column in a narrow tube than in a wide one. (3) The yield of active nitrogen comes to a limit as the length of positive column traversed by the gas is increased. (4) A trace of oxygen (or almost any other admixture) is known greatly to increase the yield of active nitrogen. The amount of oxygen required to do this considerably increases the fall of potential at the kathode, but it does not measurably affect the fall of potential in the positive column. (5) Active nitrogen is produced by the spark at atmospheric pressure. (6) The metal scattered from a copper kathode when the discharge passes can be made to emit its line spectrum in a stream of active nitrogen.—Dr. R. A. **Houstoun**: A theory of colour vision. The paper explains the facts of colour-mixing by assuming the existence of *one* class of oscillators in the retina with a free period in the middle of the spectrum. Owing to disturbing influences, the vibrations of these oscillators are never monochromatic, but, when represented by a Fourier integral, contain a range of wave-lengths. Thus, even if the incident light is pure red or pure green, the vibrations contain yellow as well. Hence, if the vibrations of the oscillators are identified with subjective light, simultaneous excitation of the eye with red and green produces yellow.—Col. R. L. **Hippisley**: Linkages illustrating the cubic transformation of elliptic functions. The linkage consists of three parts. First, a closed linkage consisting of three identical three-bar linkages in various phases of deformation connected together by bars equal in length to the traversing links, which, as has been described in the Proc. Lond. Math. Society, series 2, vol. xi., indicates the positions of the points where the poristic triangle touches its inscribed circle. Secondly, three positive Peaucellier cells which point out the positions of the vertices of the triangle. Thirdly, a closed linkage similar to the first, which gives the position of the orthocentre. This orthocentre describes a circle, and it can be shown by a few lines of vector geometry that its angular displacement is the sum of the angular displacements of the circumradii of the vertices of the triangle. The angles which these radii make with the axis are the double amplitudes of the elliptic functions which express the positions of the vertices, namely, $am(u+\frac{4}{3}s'\mathrm{K})(s'=0, 1, 2)$.

Linnean Society, May 4.—Prof. E. B. Poulton, president, in the chair.—E. A. **Bunyard**: The origin of the garden red currant. The red currant has been cultivated from the early fifteenth century, and was at first pure *R. vulgare*; for 100 years no variations were recorded. *R. petraeum* was introduced into gardens in 1561 by Konrad Gesner, and a few years after Camerarius mentions the "old" red and a new variety, "baccis rubris majoribus." *R. rubrum* seems to have come into currant history at a later date. The author considers that interhybridisation of the three species—*R. vulgare, R. rubrum*, and *R. petraeum*—is sufficient to account for the numerous varieties of the red currant as grown in gardens to-day, and the supposed effects of cultivation need not in this case be invoked.—Dr. J. C. **Willis**: The dispersal of organisms, as illustrated by the floras of Ceylon and New Zealand. In two recent papers on the flora of Ceylon, and in a forthcoming one on the flora of New Zealand, the author had brought forward conclusions on geographical distribution which, if accepted, will remove that subject from the immediate realm of evolution, and show that it may be largely studied by arithmetical methods. Once a species is evolved, its distribution depends upon causes which act mechanically. As all families and genera behave alike, it seems to him that one cause only must be responsible for their behaviour, but a combination of causes may be acting, though in that case each cause must act mechanically on all alike. The cause which seems the determining factor in dispersal is *age* within the country concerned.—R. J. **Tillyard**: A study of the rectal breathing apparatus in the larvæ of the Anisopterid dragonflies.—W. E. **Collinge**: Description of a new species of Idotea (Isopoda) from the Sea of Marmora.

Zoological Society, May 9.—Dr. S. F. Harmer, vice-president, in the chair.—Miss Dorothea M. A. **Bate**: A collection of vertebrate remains from the Har Dalam Cavern, Malta. Birds are most numerously represented, and include some bones of an Anserine bird showing a reduction in its powers of flight. It is believed to be a hitherto undescribed species, and is referred to the genus Cygnus. A list is given of all the species of vertebrates recorded from the Pleistocene cave and fissure deposits of the island.—Dr. J. C. **Mottram**: An experimental determination of the factors which cause patterns to appear conspicuous in Nature. A series of experiments was carried out with artificial patterns and backgrounds under controlled conditions of lighting, and a large number of determining factors were discovered, both as regards plain and patterned objects and backgrounds. Finally, the experiments showed that the most conspicuous shape and pattern which an object can have, when viewed against a series of plain and patterned backgrounds, was presented by a circular disc of black, with a central circular area of white. Having arrived at this conclusion, the Indian diurnal Lepidoptera were completely examined, in order to discover whether any species presented patterns approaching this ideal conspicuous pattern. It was found that a considerable number presented patterns scarcely removed from this ideal, and that a large proportion of these insects are considered to be "protected" species presenting "warning coloration."

Geological Society, May 10.—Dr. Alfred Harker, president, in the chair.—F. R. C. **Reed**: Carboniferous fossils from Siam. The fossils described in this paper were collected by the Skeat Expedition from Cambridge in the year 1899, at a locality called Kuan Lin Soh, in the Patalung district of Lower Siam, and were briefly mentioned in the "reports" of the British Association for 1900 and 1901. They occur in a pale, fine-grained, jointed siliceous rock, with an irregular or subconchoidal fracture. The field-relations of the beds have not been recorded. The general facies of the small fauna which the available material has yielded indicates a Lower Carboniferous age for the beds, and the affinities of the species seem to be European, and suggest the Culm Series.—H. G. **Smith**: The Lurgecombe Mill lamprophyre and its inclusions. A lamprophyre-dyke intrusive into Culm Shales has recently been exposed at Lurgecombe Mill, near Ashburton (South Devon). The rock is compact and fine-grained, small crystals of biotite imparting to it a characteristic lamprophyric appearance; vesicles with secondary minerals appear towards the margins. In thin section, idiomorphic biotite, olivine-pseudomorphs, and felspars are seen to make up the bulk of the rock; chlorite and secondary quartz occupy the interstices. One of the thin sections was seen to contain crystals of blue corundum associated with magnetite, in a patch which was obviously foreign to the rock. With the object of obtaining additional examples many slices were cut, sections being made of those that seemed promising. In this way several of these inclusions were obtained, the largest being about 0·3 in. in diameter. All contain corundum and magnetite, but in some cases staurolite also is present and, more rarely, green spinel.

Royal Meteorological Society, May 17.—Major H. G. Lyons, president, in the chair.—L. C. W. **Bonacina**: The readjustment of pressure differences: two species of atmospheric circulation and their connection. The paper dealt with a dynamical connection between two essentially distinct types of atmospheric circulation, familiarly exemplified in cyclonic gales on one hand, and in thunderstorms on the other.

DUBLIN.

Royal Dublin Society, April 18.—Prof. Hugh Ryan in the chair.—Prof. G. T. **Morgan**: Utilisation of nitre cake. Among many sources of economic waste occasioned by the war, one of the most extensive is the loss of sulphuric acid and alkali involved in the throwing away of enormous quantities of nitre cake (crude sodium hydrogen sulphate), the by-product of the manufacture of nitric acid from Chili saltpetre. Many proposals have been made for the profitable disposal of this waste product, some of which have been put into practice. In experiments carried out by the author in the Royal College of Science for Ireland this nitre cake was converted into glass or into an insoluble frit suitable for making glasses or glazes. Nitre itself is difficult to transport or to store because of its highly corrosive nature. When fused with sand it is converted into an insoluble, innocuous frit. Preferably it can be fused with sand and limestone, when soda-lime glass is produced, and more than two-thirds of the contained sulphur can be recovered as sulphuric acid and free sulphur. Nitre cake can be used in making soda-lead glass, which, when tinted with coloured oxides, is suitable for ornamental glass. Nitre cake should certainly not be dumped into the sea, as at present practised, without the attempt being made to utilise its contained soda and sulphur in a profitable manner. The experiments were made largely on materials obtained in Ireland, namely, nitric cake from Arklow, sand from County Donegal, Skerries limestone, and lead from Ballycorus.

PARIS.

Academy of Sciences, May 8.—M. Camille Jordan in the chair.—G. **Humbert**: Certain principal circle groups connected with the quadratic forms of Hermite.—G. **Lemoine**: The catalysis of hydrogen peroxide in heterogeneous medium. Third part: Experiments with oxides. The catalytic effect of ferric oxide varied greatly with the physical condition of the oxide. Data are given for experiments with alumina, ceria, silica (in two forms), and thoria. The possibility of the formation of peroxides with the insoluble oxides is discussed.—H. **Le Chatelier** and F. **Bogitch**: The estimation of carbon by the Eggertz method. The experiments vary from the usual method of solution in that the nitric acid is always kept at its boiling point. Each of the factors—concentration of acid, speed of attack, exposure to light, comparison temperature, turbidity of the liquid, duration of heating, volume of the acid liquid, and purity of the acid—has been studied separately with respect to its effect on the colour produced.—W. **Sierpinski**: The theory of ensembles: a general property of ensembles of points.—M. **Etienne**: The working of the electrolytic detector.—G. **Lecointre**: Some results of a geological expedition in the Gharb (western Morocco) in 1914.—P. **Lecène** and A. **Frouin**: New researches showing the reality of latent microbism in cicatrised shot wounds. Twenty-four cases of wounded were examined for the presence of organisms, capable of cultivation, at the surface of projectiles enclosed in the tissues. In all of these the wounds were perfectly cicatrised, and after several months there was no trace of inflammation. In three cases the projectile gave a sterile culture; in seventeen various micro-organisms, including staphylococci, streptococci, and bacilli, were obtained from the bullet. In four cases the projectile and the fibrous envelope were removed together, like a small tumour. The projectiles themselves proved to be sterile, but the internal wall of the fibrous clot gave both cocci and bacilli on cultivation. The bearing of these results on the surgical treatment of projectile wounds is discussed.

BOOKS RECEIVED.

Department of Commerce. U.S. Coast and Geodetic Survey. Serial No. 19: Results of Observations made at the U.S. Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, 1913 and 1914. By D. L. Hazard. Pp. 98. (Washington: Government Printing Office.)

The Stars as Guides for Night Marching in North Latitude 50°. By E. W. Maunder. Pp. 72. (London: C. H. Kelly.) 2*s.* net.

The Respiratory Exchange of Animals and Man. By Dr. A. Krogh. Pp. viii+173. (London: Longmans and Co.) 6*s.* net.

Plants in Health and Disease. By Prof. F. E. Weiss, Dr. A. D. Imms, and W. Robinson. Pp. viii+143. (Manchester: The University Press; London: Longmans and Co.) 1*s.* 6*d.* net.

Agriculture after the War. By A. D. Hall. Pp. vii+137. (London: J. Murray.) 3*s.* 6*d.* net.

Tuberculosis and the Working Man. By P. C. Varrier-Jones. Pp. 47. (Cambridge: W. Heffer and Sons, Ltd.) 6*d.* net.

Board of Agriculture and Fisheries. Agricultural Statistics, 1915. Vol. l., part 1. Acreage and Live Stock Returns of England and Wales. Pp. 75. (London: H.M.S.O.; Wyman and Sons.) [Cd. 8240.] 4*d.*

Department of Commerce. Circular of the Bureau of Standards, No. 58. Invar and Related Nickel Steels. Pp. 68. Technologic Papers of the Bureau of Standards. No. 71. Effect of Certain Pigments on Linseed Oil. Pp. 16. By E. W. Broughton. Scientific Papers of the Bureau of Standards, No. 273. General Design of Critically Damped Galvanometers. By F. Wenner. (Washington: Government Printing Office.)

The Effects of Radio-active Ores and Residues on Plant Life. Bulletin No. 7. A Report of the Second Series of Experiments carried out at Reading, 1915. Pp. 20. (Reading: Sutton and Sons.) 2*s.* 6*d.* net.

University of Hongkong. Calendar, 1915–16. Pp. 124. (Hongkong.)

Annuaire général de Madagascar et Dépendances. (Modifications à l'Annuaire, 1914.) Pp. 227. (Tananarive.)

Department of Agriculture and Technical Instruction for Ireland. Programme of the Irish Training School of Domestic Economy. Session 1916–17. Pp. 21. (Dublin.)

The Brooklyn Institute of Arts and Sciences. Brooklyn Museum Science Bulletin, vol. iii., No. 1. Long Island Fauna. iv., The Sharks. By J. T. Nichols and R. C. Murphy. (Brooklyn, N.Y.)

Annals of Tropical Medicine and Parasitology. Vol. x., No. 1. April 29. Pp. 164. (Liverpool: University Press.) 7*s.* 6*d.* net.

The Journal of the Royal Agricultural Society of England. Vol. lxxvi. Pp. 8+364. (London: John Murray.) 10*s*.

The Microscopy of Vegetable Foods. By Dr. A. L. Winton, Prof. J. Moeller, and Dr. K. B. Winton. Second edition. Pp. xiv+701. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 27*s*. 6*d*. net.

Sewerage: The Designing, Construction, and Maintenance of Sewerage Systems. By A. P. Folwell. Seventh edition. Pp. x+540. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

The Journal of the South African Ornithologists' Union. Vol. xi., No. 1. December, 1915. Pp. 118. (Pretoria; London: Witherby and Co.) 7*s*.

The Nestorian Monument in China. By Prof. P. Y. Saeki. Pp. x+342. (London: S.P.C.K.) 10*s*. 6*d*. net.

Text-Book of Mechanics. By Prof. L. A. Martin, jun. Vol. vi., Thermodynamics. Pp. xviii+313. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

Geodetic Surveying. By Prof. E. R. Cary. Pp. ix+279. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Interpolated Six-place Tables of the Logarithms of Numbers and the Natural and Logarithmic Trigonometric Functions. Edited by H. W. Marsh. Pp. xii+155. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

The Thermodynamic Properties of Ammonia. By F. G. Keyes and R. B. Brownlee. Pp. v+73. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 4*s*. 6*d*. net.

The Universal Mind and the Great War. By E. Drake. Pp. vi+100. (London: C. W. Daniel, Ltd.) 2*s*. 6*d*. net.

Methods in Practical Petrology. By H. B. Milner and G. M. Part. Pp. vii+68. (Cambridge: W. Heffer and Sons, Ltd.) 2*s*. 6*d*. net.

Record of a Prehistoric Industry in Tabular Flint at Brambridge and Highfield, near Southampton. By R. E. Nicholas. Pp. 92. (Southampton: Toogood and Sons.)

Alfred Russel Wallace: Letters and Reminiscences. By J. Marchant. Vol. i., pp. xi+320. Vol. ii., pp. vi+291. (London: Cassell and Co., Ltd.) 25*s*. net.

The Design of Aeroplanes. By A. W. Judge. Pp. viii+212. (London: Whittaker and Co.) 9*s*. net.

The Small Grains. By M. A. Carleton. Pp. xxxii+699. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

Steering by the Stars: for Night-flying, Night-marching, and Night Boat-work between Latitudes 40° N. and 60° N. By Dr. J. D. White. Pp. 32. (London: J. D. Potter.) 1*s*.

Tunbridge Wells and Neighbourhood: A Chronicle of the Town from 1608 to 1915. By H. R. Knipe. Pp. 207. (Tunbridge Wells: Pelton.)

DIARY OF SOCIETIES.

THURSDAY, MAY 25.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: X-Rays and the Theory of Radiation: Prof. C. G. Barkla.

ROYAL INSTITUTION, at 3.—The Beginnings of the Orchestra and its Instrumental Combinations: Sir Alexander Mackenzie.

OPTICAL SOCIETY, at 8.—Sands used in Glass-making, with Especial Reference to Optical Glass: Dr. P. G. H. Boswell.

FRIDAY, MAY 26.

ROYAL INSTITUTION, at 5.30.—X-Rays: Prof. C. G. Barkla.

PHYSICAL SOCIETY, at 5.—The Correction of Chromatic Aberrations when the External Media are Dispersive: T. Smith.—Note on the Use of the Auto-collimating Telescope in the Measurement of Angles: J. Guild.—The Viscosity of Colloidal Solutions: E. Hatschek.

SATURDAY, MAY 27.

ROYAL INSTITUTION, at 3.—The Finance of the Great War: Prof. H. S. Foxwell.

TUESDAY, MAY 30.

ROYAL INSTITUTION, at 3.—Optical Research and Chemical Progress: Dr. T. M. Lowry.

THURSDAY, JUNE 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Scattering of Plane Electric Waves by Spheres: Dr. T. J. I'a Bromwich.—Numerical Results of the Theory of the Diffraction of a Plane Electromagnetic Wave by a perfectly conducting Sphere: J. Proudman, A. T. Doodson, and G. Kennedy.—Motion of Solids in Fluids when the Flow is not Irrotational: G. I. Taylor.

ROYAL INSTITUTION, at 3.—Chamber Music and its Revival in England: Sir Alexander Mackenzie.

ROYAL SOCIETY OF ARTS, at 4.30.—The Work of the Imperial Institute for India: Prof. W. R. Dunstan.

FRIDAY, JUNE 2.

ROYAL INSTITUTION, at 5.30.—La France dans l'Histoire comme Champion du Droit: Lieut. P. H. Loyson.

GEOLOGISTS' ASSOCIATION, at 7.—The Petrology of the North Sea Drift and Suffolk Brick-earths: Dr. P. G. H. Boswell.—Notes on Erosion Phenomena in Egypt: Mary S. Johnston.

SATURDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Folk-lore in the Old Testament: Sir James G. Frazer.

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THURSDAY, JUNE 1, 1916.

APPLE-GROWING FOR PROFIT.

The Apple: a Practical Treatise dealing with the Latest Modern Practices of Apple Culture. By A. E. Wilkinson. Pp. xii+492. (Boston and London: Ginn and Co., 1915.) Price 8*s*. 6*d*.

MR. WILKINSON'S monograph is a very good example of a type of book which is indigenous to the New World. Writers of such monographs look at their subject keenly and exclusively from its commercial aspect. They collect or recount from their experience every item of information the possession of which by a grower is calculated to make his proposition pay; with equal ruthlessness they exclude everything a knowledge of which does not appear likely to lead to monetary profit.

Thus the present work abounds in sound and useful information on every section of commercial apple-growing, yet it neither mentions nor describes any form of training other than that for the production of a "vase"-shaped (open-headed) or pyramidal standard. Espaliers, cordons, and the subtler forms of trained tree beloved of thrifty Frenchmen are ignored completely. The American apple-tree has, in truth, been standardised, and the form prescribed is the low standard. Dwarfing stocks are allowed—in the home garden. Similarly, admirable accounts are given of frost prevention by the use of "heaters," of picking, packing, grading, marketing, and advertising, yet the descriptions of the chief varieties of apple are so brief and unclassified that growers would have the greatest difficulty in naming an unknown variety which happened to come into their hands.

So long as information has a commercial bearing it may, however, be included, even though it lack precision. For example, colour appears to be a very important attribute of American apples, and accordingly the subject is considered with some thoroughness, and quite inconclusive experiments are cited, as, for example, those on the influence of manuring with potash salts on the production of colour. Science is trying hard to discover what determines coloration in fruit, and why the colour should show from year to year such remarkable variations in one and the same variety; but its efforts so far have been unsuccessful, and the information that science can give on this subject is scarcely worth the attention of the grower.

There is, however, another aspect of the American type of monograph well exemplified in this book which deserves nothing but praise and emulation. That is the resolute thoroughness with which fundamental problems are envisaged. For example, we in this country are content to recognise that certain varieties of apple do well in certain districts and badly in others. We may go so far as to make inquiry on the subject and publish the results—a work upon which the Fruit Committee of the Royal Horticultural Society is now engaged. The American does better than this. He endeavours to discover what are the soil requirements of different varieties of apple, and in this inquiry he is, apparently, so successful that he is able to speak of and describe a "Baldwin" soil, a "Northern Spy" soil, or a Rhode Island "Greening" soil.

So excellent are the brief introductory chapters on selection of site and adaptation of varieties to soil that we can imagine some strenuous urban American exclaiming on reading them: "Sure, I can grow apples," and forthwith setting out and growing them—perhaps successfully.

Needless to say, the chapters on spraying and on insect and other pests are well done. Lime-sulphur increases yearly in favour with American growers, and, indeed, the spraying schedule recommended by the College of Agriculture of Cornell University comprises four annual sprayings with lime-sulphur, to which, if insects are to be destroyed as well as parasitic fungi, arsenate of lead is added.

The subject of breeding is treated somewhat briefly; Mendelism is glanced at. The statement (p. 425), "A breeder cannot obtain wholly new characters in apples by making Mendelian combinations," requires elaboration if it is not to be misleading; and the list (p. 414) "showing both self-sterile and self-fertile varieties" appears to contain only shy, average, or prolific pollen-bearers. It is curious that little or no reference is made either to the history and origins of the apple nor to recent work, as, for example, that conducted by the Duke of Bedford and Mr. Spencer Pickering at Woburn on economical methods of planting.

The book is well written by the hand of an expert. It should meet with wide success in America, and should be read with attention by all interested in fruit-growing in this country.

F. K.

THERMODYNAMIC CHEMISTRY.

An Introduction to the Principles of Physical Chemistry from the Standpoint of Modern Atomistics and Thermodynamics. By Prof. E. W. Washburn. Pp. xxv+445. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., 1915.) Price 15*s*. net.

TEACHERS and students alike should be grateful to Prof. Washburn for supporting the use in physical chemistry of the differential and integral calculus, which he introduces freely in the work now under review. Students will be surprised when they see how little calculus they need, and how much that little will strengthen the grip they get of physical chemistry. The time required for acquiring the necessary knowledge of calculus is nothing compared with the time wasted in wading through the tedious mathematics involved in evading the calculus. It is not only a waste of time—it is also misleading—to subject a number of difficulties each to a separate treatment, as is done when no calculus is used, as if they were of several quite distinct kinds in cases where they might be ranked together and enfiladed in a single attack.

P

In the application of thermodynamics to chemistry a method of purely mathematical analysis may be adopted or the principle of the efficiency of the perfect thermodynam.c engine may be applied directly to physico-chemical phenomena, as is done by Prof. Washburn, who, however, simplifies the usual procedure by devising a specially constructed engine.

The influence of a pressure-change on equilibrium receives practically no quantitative treatment in most text-books; in this work it receives more of the attention it deserves. The author discusses the effect of extra pressure not only when applied to all the phases, but also when applied to one phase only. This last we consider of great importance in elucidating so-called "osmotic pressure," which is a special case of what we may call one-phase pressure.

Under the treatment of the influence of a temperature-change on equilibrium we find no reference to Nernst's complete integration of the differential equation, though Nernst's modification of Trouton's rule is mentioned. On the other hand, there is an excellent account of specific heat, without, however, applying the quantum theory.

The chapters on electro-chemistry are decidedly good, but we should prefer, for teaching purposes, a different order. It would be better to have a special chapter for E.M.F., which, so far as possible, should be kept separate from Faraday's laws and conductivity. We hope that in future editions the author will deal more fully with potential differences at interfaces generally on account of their importance in the theory of colloids; and for the same reason there should be more about the mechanical forces at interfaces.

Equilibrium, especially in solutions, is treated with a thoroughness unusual in introductory text-books. Mention is made of many recent advances in physical chemistry, and valuable references to literature help to make up for the rather scanty account given of some sections of the subject. There are brief biographical footnotes, numerous cross-references, and problems for practice in calculation. The printer's errors are few and not at all serious.

This excellent work is well worthy of the earnest study of both teachers and students.

FRANCIS W. GRAY.

APPLIED MECHANICS.

(1) *Elementary Applied Mechanics.* By Prof. T. Alexander and Prof. A. W. Thomson. Third edition. Pp. xx+512. (London: Macmillan and Co., Ltd., 1916.) Price 15*s*. net.

(2) *Applied Mechanics: First Year.* By H. Aughtie. Pp. 184. (London: G. Routledge and Sons, Ltd., 1915.) Price 2*s*. net.

(3) *Textile Mechanics.* By W. Scott Taggart. Pp. vii+117. (London: G. Routledge and Sons, Ltd., 1915.) Price 2*s*. net.

(1) PROFS. ALEXANDER AND THOMSON'S "Elementary Applied Mechanics" is an excellent treatise—a development of a much smaller one which engineers knew thirty years ago. It follows chiefly the methods of Rankine, but with a larger use of graphic constructions. It is a feature that the graphic diagrams are to scale, and are, in fact, exercises worked out. Appended to each chapter are examples fully worked out. On the mathematical side and within its range the treatment is complete. On the practical side it is not quite so satisfactory. The data of weights, working stresses, etc., involved in any practical solution are very scantily given, and the considerations which lead a designer to modify purely theoretical results are little touched on. In this the authors differ from Rankine, who took so much trouble with the data that his values are still of authority after fifty years, and are sometimes quoted in this book. For instance, the one essential starting point in roof design is the magnitude and distribution of the wind pressure. The authors merely assume a wind at 45° with the rafter, on one side of the roof, with a normal component 25 per cent. greater than the weight of the roof at each joint. But the wind pressure has nothing to do with the weight of the roof, and its distribution is not that assumed.

The problem of rolling loads on bridges is treated fully and with originality. The bending-moment diagram of circular arcs is interesting and useful. The maximum moment for any section for any travelling loads is fully discussed. The moving model which draws the bending-moment curve for a trolley is very ingenious, but it seems to us more difficult to follow than the ordinary demonstration.

On the subject of earth pressure Rankine's frictional theory is followed, without reference to the reservations he himself makes or to the numerous investigations which have shown how in most ordinary cases, except for dry sand, it is not even a good approximation. For retaining walls the deviation of the centre of pressure from the centre of the joint is taken at 3/10ths of the width without any explanation. It is a critical point, and needs defence.

Long struts are treated well, but only by the use of the Gordon-Rankine formula. The authors say that Rankine proved Gordon's formula to be rational. This is disputable; it is really an interpolation formula between Euler's and that for short columns. The various formulæ which are more convenient in use, and are, in fact, largely used in design, are not referred to.

Arched ribs are treated by Levy's graphic method, and there is an interesting and original chapter on masonry arches, though, perhaps, the treatment is too abbreviated to be very useful. Curiously, reinforced arches, now so important and affording such excellent scope for scientific treatment, are not alluded to.

The treatise is excellently printed and illustrated, and will certainly be useful to students and engineers. It seems a defect that the book has only a table of contents and no index.

(2) This is a very elementary book, in which ordinary mechanics, kinematics of machines, and some problems in work and power are treated

largely descriptively and with the help of numerical illustrations and simple experiments. The printing and diagrams are clear. But one may be allowed to ask why here, as in many other books, the so-called laws of friction deduced for dry surfaces and low intensities of pressure are given without a hint that in most cases they are more disobeyed than obeyed? Also, is such a very roundabout way of finding the work of a fluid pressure (Fig. 121) really helpful to a student?

(3) Mr. Taggart's book is similar to the foregoing, but it is more specialised, the illustrations being taken from textile machinery. It is more original, therefore, and is likely to be of service to textile workers, both in explanation of the machines they use and in familiarising them with some of the technics of the industry.

OUR BOOKSHELF.

On the Relation of Imports to Exports: A Study of the Basis of a New National and Imperial Policy. By J. Taylor Peddie. Second edition (enlarged). Pp. xxiv + 148. (London: Longmans, Green and Co., 1916.) Price 5*s*. net.

MR. TAYLOR PEDDIE'S book is written in favour of what he calls National Economics. "National Economics," he says, "to be based on freedom of trade, must come under the heading of low tariff duties, for high tariff duties are protective." Now, if low tariffs do not protect, what is their object? In his third essay Mr. Taylor Peddie attempts to answer this question. "British manufacturers . . . will have to submit . . . to a heavy income tax and other heavy direct taxation. . . . Is it, then, an equality of rights that American manufacturers . . . should in future be allowed to enter into free competition with our own productions?" Mr. Taylor Peddie has, in fact, rediscovered, repainted, and reclothed that ancient figure of fun, the mid-nineteenth-century French Free Trade school's Scientific Tariff, and, with the true artist's "temperament," he has fallen deeply in love with it!

True, his tariffs lack something in scientific precision, for he has found a special magic in the figure 17½ per cent., and no duty must exceed that amount. But their achievements more than compensate for all purely academic desiderata. His "low tariffs," apparently, are to counterbalance the adverse balance of trade, although (p. 42) he assures us that Free Trade has not produced that adverse balance. His "low tariffs" are to have no effect on prices, but to restrict imports (without protecting), increase the national productive capacity, the revenues of the State, and the distribution of wages, and although not affecting prices (p. 39) we can sell cheaper (p. 40). Mr. Taylor Peddie is, indeed, to be congratulated on his perversely paradoxical panacea.

On p. 98 we are told that "we shall never be able to destroy German industrialism by allowing National Economic questions to be discussed in the abstract or as platitudes." If "National Economics" are really to be framed with the object of destroying industrialism, we are perhaps justified in hoping that they will quickly become what Mr. Taylor Peddie believes the history of political economy for the main part to be—"a record of absurd and justly exploded opinions." A. L.

A Manual on Explosives. By Albert R. J. Ramsey and H. Claude Weston. Pp. xi + 116. (London: George Routledge and Sons, Ltd., 1916.) Price 1*s*. net.

THIS little manual is intended to furnish to the munition worker, as well as to the general reader, concise information on the nature of explosives and on their manufacture, and further to emphasise the very important part which explosives play in the sphere of modern engineering. It is certainly an excellent little primer. Particularly good is the description of the manufacture of nitro-cellulose, nitro-glycerin, and the modern high explosives, the text being illustrated by excellent diagrammatic representations of the various plants employed. The authors have shown considerable discretion in the allotment of space to the different explosives, but more might well have been devoted to propellants. Smokeless powers, other than cordite, scarcely receive mention. The description of the manufacture of cordite is very brief, and it is a pity the authors give only the composition of Mark I. cordite, which, through the serious erosion it produced in the guns, was superseded some years ago by M.D. cordite, containing less nitro-glycerin.

A short chapter is devoted to fuses and detonators, another to the application of explosives, some interesting examples of engineering applications being given. A valuable chapter is one on "Industrial Poisoning among Explosive Workers and its Prevention," in which the authors deal with the symptoms by which poisoning may be recognised, the general lines of first-aid treatment, and enumerate some of the simple precautions which should be adopted to minimise risk of poisoning. Such chemistry as is necessary to follow the various processes and relating to the composition of explosives is very clearly set out, and altogether the book admirably fulfils the intentions of the authors.

Yorkshire's Contribution to Science—with a Bibliography of Natural History Publications. By T. Sheppard. Pp. 233. (London: A. Brown and Sons, Ltd., 1916.) Price 5*s*. net.

THE object of this volume is to provide students of the natural history of Yorkshire with a guide to all sources of information likely to be of service to them. Many workers in biological and geological science will be grateful to Mr. Sheppard for the particulars he has brought together about Yorkshire periodical publications dealing with natural history, Yorkshire scientific magazines now extinct, and Yorkshire topographical and general magazines. The particulars concerning other British scientific journals and societies and the list of works of reference add to the completeness of the volume.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Meteorological Conditions of a Blizzard.

I AM glad to see Mr. Bostwick's protest against the current use of the word "blizzard," and agree with him that the British Isles, excluding mountains like Ben Nevis, cannot produce the conditions for a real blizzard.

There can be no comparison between the phenomenon as it occurs in North America and the polar regions and the very mild imitation commonly called a blizzard in the English daily Press. In most cases the latter consists of a mixture of snow and rain, perhaps not amounting to more than 0·10 in. in all, and a wind not exceeding a strong breeze.

The only approach to a blizzard in the S.E. of England during the last fifty years was on January 18, 1881. On that occasion the dry snow and the gale were present, but not the low temperature. Much inconvenience was caused by the drifts and stoppage of traffic, but hundreds of thousands of persons probably made their usual outdoor journeys on that day in their usual clothing without danger, a thing they could not have done had the third condition of a really low temperature been fulfilled.

W. H. DINES.

Benson, Wallingford.

Economic Work of the Geological Surveys.

THE note on Sir Robert Hadfield's address to a Committee of the Advisory Council for Scientific Research, given in NATURE for May 25 (vol. xcvii., p. 264), suggests that the speaker was ill-informed as to the recent history of the Geological Surveys of our islands. The activities of what Sir Robert Hadfield styles "the Geological Survey" have naturally been "restricted" as regards Ireland, since the Geological Survey of that country was placed under the Irish Department of Agriculture and Technical Instruction so far back as 1905. So soon as the need for more detailed information as to our mineral resources became apparent, through the pressure of military operations, the staff in Ireland was devoted to the preparation of a reference index to all known mines and mineral localities in the country, and the inquiries that are almost daily dealt with already show the utility of the material thus brought together.

The remark quoted from Sir Robert Hadfield's address as to the basis on which our knowledge of Irish minerals rests must surely refer to some officer in England. The Department of Agriculture in Ireland employs, in addition to the staff of its Geological Survey, an officer entitled the "Economic Geologist," possessed of special mining qualifications, whose advice is always at the service of those who may be desirous of developing mineral industry in the country. Surely the combined work of the Geological Surveys and of the mining officials already employed in the public service should obviate the creation of a new "Central Imperial Bureau." The deficiency of information has long been due to public ignorance of the value of the material brought together by public servants, an ignorance unhappily shared by many who pose as mine prospectors.

GRENVILLE A. J. COLE.

Geological Survey of Ireland,
14 Hume Street, Dublin, May 27.

ANTARCTIC PHYSIOGRAPHY.[1]

DR. GRIFFITH TAYLOR, physiographer to the Commonwealth of Australia, accompanied Capt. Scott's last Antarctic Expedition as its chief physiographer, and in this interesting volume he records his experiences, gives brief summaries of his observations and conclusions, and describes the daily life and incidents of the enterprise. His scientific results will be given more fully and connectedly in the special volumes on the work of the expedition. His narrative is mainly of interest as a preliminary statement of his conclusions, and for his racy account of the life of the expedition and pleasing picture of the good humour and happy comradeship between all its members.

FIG. 1.—Photo from the ship of Cape Evans, January 26, 1911. The Tunnel Berg appears on the right. Behind is the dark line of the Ramp, and twelve miles away the cone of Erebus with a small steam cloud. From "With Scott: The Silver Lining."

Dr. Taylor's chief contributions to the history of the expedition are his accounts of the voyage from New Zealand to Macmurdo Sound, of the winter's life at the base there, and of the two expeditions under his command to the mainland on the western side of Macmurdo Sound. During his sledge journeys in that area he was able to supplement the observations of Ferrar, David, and Mawson, and by combining all the materials available has produced the most detailed map of any part of eastern Antarctica. It is an area of special interest, as the glaciers descend towards the coast through a series of remarkable valleys which notch the edge of the Antarctic plateau. Dr. Taylor's party followed the Ferrar Glacier

1 "With Scott: The Silver Lining." By Dr. Griffith Taylor. Pp. xiv+464. (London: Smith, Elder, and Co., 1916.) Price 18s. net.

westward to an upper section, which has been named the Taylor Glacier. The origin of the glacier valleys has not yet been fully explained, but the solution of the problem may be furnished by the detailed geological and geographical information collected by Dr. Taylor and his comrades.

Dr. Taylor's special attraction to Antarctica was the opportunity of studying the physiography of an area where water action had been always either absent or relatively insignificant compared with glacial erosion. It is interesting to note that his Antarctic studies have led him to reduce the importance he had once assigned to ice erosion. He now attaches more importance to the shattering action of frost than to the actual erosive influence of glacier ice. The front of the Antarctic plateau which rises above the Ross Sea has been hollowed into the great rounded depressions known as corries or cirques; and these features have long been attributed by many glacialists to the direct excavating action of glaciers. Dr. Taylor, however, adopts the conclusion that they are essentially due to the action of frost. This explanation was first clearly advanced by Prof. Cole in 1895, and though long rejected it has been largely adopted in recent years. The indefiniteness of the characters used to distinguish glacial from water erosion is illustrated by some of Dr. Taylor's observations. Thus he figures a hill slope which appears to be an ordinary denudation curve; he attributes this catenary curve to glacial erosion, whereas probably most glacialists regard the opposite denudation curve, which is oversteepened at the end owing to the toe of the slope having been worn away, as the characteristic feature of glacial denudation.

One item in Dr. Taylor's physiographic nomenclature is open to regret, since he has followed a growing custom of adopting an ordinary German term with a special technical meaning. He uses the term "riegel" for a rock bar across a glaciated valley. In his first reference to the structure he calls it a bar or riegel; but afterwards he uses only the latter. The word "bar" is the recognised English term, and it is used in geography, and there seems no need to introduce a foreign word. German authors adopt the term "riegel" because it is the natural word for them to use in describing this structure; and there seems no more reason why British authors should call such a formation a riegel than why German geographers should call it a bar. It may be said that the term "bar" is ambiguous, and can only be understood by the context, but exactly the same objection applies to "riegel."

In reference to the general physiographic Antarctic problems, it is interesting to note that

FIG. 2.—The field of crevasses (Skauk) at the root of Mackay Tongue, January 6, 1912. Behind are the faceted slopes of Mount Allan Thomson. Photo from the Flat Iron looking N.W. From "With Scott: The Silver Lining."

Dr. Taylor believes in the connection advocated by Filchner between the Ross and Weddell Seas. From the account of the researches by Dr. Simpson it appears not improbable that the most important of the scientific results of the expedition will be the additions to Antarctic meteorology.

The book is illustrated by numerous excellent photographs, including some by the expert Antarctic photographer, Mr. Ponting, and also many instructive and ingenious diagrammatic sketches by Dr. Taylor. He publishes a photograph of the *Discovery* Hut in which he lived for a month, and the title directs attention to one feature which shows that the hut was not built as designed; for it is raised on supports which were only to have been used if the hut had to be erected on ice into which they could have been easily sunk.

One interesting psychic incident is recorded. At about the time when Amundsen turned back from the South Pole his compatriot Gran had a dream to that effect, and promptly recorded it in one of Dr. Taylor's books. The author regards it as a coincidence, but his remarks suggest that he is not very confident of this explanation.

PTOLEMY'S CATALOGUE OF STARS.[1]

JUST forty years ago the late Prof. Peters, of Clinton, New York, and Mr. Knobel began independently, and without either of them knowing of the other's work, to investigate the Catalogue of Stars in Ptolemy's Almagest. They soon, however, got into correspondence, and eventually met in Paris in 1887. By that time Peters had collated most of the manuscripts in Continental libraries, and Mr. Knobel then undertook to examine those in England. Peters died in 1890, and in November, 1891, most of his papers and notes bearing on the subject were forwarded to Mr. Knobel, who completed the work, and has now at last suceeded in getting it printed.

Only three editions of the Greek text of the Almagest have been published, those of Grynæus (1538), Halma (1813–16), and Heiberg (1898–1903). A valuable German translation by Manitius came out three years ago. Of the Star Catalogue there have been several separate editions, the best of which is that of Baily (Mem. R. Astr. Soc., vol. xiii.). But from an astronomer's point of view no previous edition can compare with the one we are considering here, as this is founded on an examination of a great number of codices—Greek, Latin, and Arabic—and contains, besides, many other things for which astronomers looked in vain in the earlier editions.

The investigation of Peters differs from those hitherto made, as he began by calculating from Piazzi's star-places and Mädler-Bradley's proper motions the longitudes and latitudes of all Ptolemy's stars for the epoch A.D. 100, for the purpose of identifying the stars and getting an idea of the accuracy of the positions. This was done before Auwers had published his new reduction of Bradley's observations, and it would have been worth while to examine what difference the adoption of Auwers's proper motions would have made, though the main results of the investigation would doubtless not have been affected. The work also differs from all others in the number of codices consulted. In all, twenty-one Greek and eight Latin codices of the Almagest were examined, and also three Arabic codices of the Almagest, ten of Al Sûfi's Uranometry (the catalogue in which is that of Ptolemy, with a constant correction for precession), and one of Nasir-ed-din Al Tûsi's Compendium of the Almagest. Detailed notes on the first thirty-three of these codices and three photographic plates are appended; the latter help to make the reader understand the principal sources of error in the catalogue.

The original catalogue was doubtless written in the uncial Greek characters of the second century, and the most common error in all manuscripts is that of confounding the uncial alpha (=1) and delta (=4). Thus the magnitude of θ Eridani is given in all Almagests as 1 instead of 4, which hitherto has puzzled everybody, while the Bodleian Greek Almagest gives the magnitude of Sirius as 4. Errors are also caused by confusion between Α and Λ (=30) or $\epsilon=5$ and $\theta=9$, etc. The Arabic MSS. are especially important for comparison with the Greek, as the errors are of a different kind. Unlike the Greeks, who wrote the minutes of longitude and latitude as fractions of a degree, the Arabs wrote the minutes in figures, and thus these two different methods form a valuable check one on the other.

The star-places finally adopted by the authors are given in three catalogues. The first contains for each star: Baily's number, the number and Latin description of the star from the Latin edition printed in 1528, the Flamsteed number and Bayer's letter, the longitude, latitude, and magnitude. The second catalogue repeats the last three items, and gives the longitude and latitude computed from Piazzi for the epoch A.D. 100, and the difference between these and Ptolemy's values; also the magnitude from the revised Harvard Photometry. The third catalogue gives Ptolemy's longitudes reduced by $2^\circ\ 40'$, being the difference which Ptolemy states he found between the longitudes of Hipparchus and those of his own time, and the latitudes unaltered; also the positions computed for 130 B.C. After a lengthy set of notes on various stars follow tables collating a number of codices as regards longitude, latitude, and magnitude.

Most writers have been of the opinion that Ptolemy's catalogue was nothing but that of Hipparchus, the longitudes being altered by adding $2^\circ\ 40'$ for precession. Peters had already published in 1877 a paper showing that modern star-places, reduced to A.D. 100 and compared with those of Ptolemy, gave a mean correction to his longitudes $= +34{\cdot}9'$, making his epoch

[1] "Ptolemy's Catalogue of Stars. A Revision of the Almagest." By Dr. C. H. F. Peters and E. B. Knobel. Pp. 207. (Washington: Carnegie Institution, 1915.)

A.D. 58 instead of A.D. 138, the alleged epoch. The year A.D. 58 is 187 years after the epoch of Hipparchus, which gives the amount of precession = 2° 36′, agreeing closely with the difference of 2° 40′ found by Ptolemy. Mr. Knobel remarks that, as the correction could not represent positions observed in A.D. 138, this supports the view that the catalogue is simply that of Hipparchus, with a constant amount added to the longitudes.

But this conclusion is by no means certain, and was not accepted by Peters when he spoke on this subject at the Kiel meeting of the Astronomische Gesellschaft in 1887, less than three years before his death. According to the very short report in the *Vierteljahrsschrift* (xxii., p. 269), Peters said that the constant error of the longitudes might very well be due to systematic errors of Ptolemy's instruments or to faults of the method (comparison of sun and stars with the moon as an intermediary), neglect of refraction, etc. The equinoxes of Ptolemy should not be assumed to possess the accuracy required to justify the above conclusion, and it would, in fact, be remarkable if such accuracy had been attained. Peters added that stars with large proper motion, especially 40 Eridani, agreed far better with the places of the stars at the time of Ptolemy than with those at the time of Hipparchus. To these reasons for hesitating to adopt the usual conclusion we would add the common belief among the Arabs that Ptolemy had borrowed his whole catalogue from Menelaus, adding 25′ (41 years' precession at 36″) to the longitudes. This seems in itself a far more likely origin of the catalogue than that it should have been borrowed from one made 270 years earlier. But the problem of the origin of Ptolemy's catalogue is still unsolved.

J. L. E. D.

PROF. H. C. JONES.

THE announcement in NATURE of May 18 of the death of Prof. Harry Jones, of Johns Hopkins University, will be received by his many friends in this country with sincere regret, for his transparent honesty and sincerity, his enthusiastic nature, his kindliness, and his courtesy impressed all with whom he came in contact.

Harry Clary Jones was born in New London, Maryland, in 1865, and received his academic education in the famous university of his State. He graduated as A.B. in 1889 and as Ph.D. in 1892. The next two years he spent in Europe working in the laboratories of Ostwald, Arrhenius, and van't Hoff. Permeated with the ideas and theories associated with these names, Jones returned to America and proceeded to promulgate them with boundless energy and enthusiasm. He received an appointment on the teaching staff of Johns Hopkins University, and was in time promoted to the chair of physical chemistry. Jones was a tireless worker himself and inspired his numerous co-workers with an equal industry. During the last twenty years he published, alone and in conjunction with them, well above a hundred papers, many of them memoirs of considerable magnitude, and found time in addition to write six books (text-books and semi-popular works), several of which have passed through a number of editions.

The line of research to which he chiefly devoted himself was the study of the intimate nature of solutions. In the "ideal" solutions of van't Hoff the mutual influence of solvent and solute may be neglected. The main object of the investigations of Jones and his fellow-workers was to ascertain the nature and extent of this influence in actual solutions. For aqueous solutions Mendeléeff had advanced the hypothesis that the dissolved substance existed in the form of a hydrate or hydrates of definite composition. Jones modified and extended this idea and held that dissolved substances in general are combined with more or less of the solvent as a series of solvates. To test this "solvate theory of solution" his extensive experimental work was devised. He explained abnormally low freezing-points of concentrated solutions as due to a portion of the solvent having combined with the solute, so that the concentration in the remaining solvent was greater than that deduced from the composition of the solution, and showed that this abnormality in aqueous solutions was greatest for those substances which crystallise most readily with water of crystallisation. By the use of the grating spectroscope he showed that the absorption bands of solutions became broader (1) as the solution became more concentrated, (2) as the temperature was raised, (3) as dehydrating substances were added. In each case this would correspond to the production of simpler hydrates. He also showed that different absorption bands were obtained according to the solvent in which the salts investigated (chiefly those of neodymium, which give sharp absorption bands) were dissolved, pointing to the formation of different solvates. By means of the radiomicrometer he demonstrated finally that the water in concentrated solutions of non-absorbing salts showed a smaller absorption in the infrared region than water itself.

Of his text-books the "Elements of Physical Chemistry" is deservedly the most successful, being written in an easy, readable style, which makes it popular with the student. In his "New Era in Chemistry" he described the progress of the science from 1887 onwards, and struck a personal note which adds to the interest and pleasure of perusal.

J. W.

NOTES.

THE Paris correspondent of the *Times* states that the Committee of the Senate appointed to consider the Daylight Saving Bill has reported against the measure on the ground that the economy intended to be realised is doubtful, and that the change would cause serious inconvenience.

IN the recent debate on the Air Board in the House of Lords several references were made to the scientific side of aeronautics. This aspect of the subject is not nearly so well known and appreciated as it should be

by the designers and constructors of our present aeroplanes. If the new Air Board succeeds in bringing about a better understanding between the practical designer and the scientific expert, and in enabling the results of scientific experiment and calculation to be used more widely in the actual production of aircraft, it will be doing a great service to the aeronautical industry. The proposal for the establishment of a separate Board of Inventions in connection with the Air Board seems to be a good one, provided that the Board consists of men who have sufficient technical knowledge to be able to discriminate between inventions of real use and the many "freak" inventions which now flood the country. A great deal of the time of scientific experts is now wasted in experimenting on inventions that should have been thrown out as obviously useless in the first place. The progress that has been made from the scientific point of view is very considerable. It is now possible to calculate with considerable accuracy the performance and stability of a new design from simple experiments on models in a wind tunnel. In the matter of scientific aeronautics we are well in advance of the enemy, except perhaps in connection with rigid airships. The chief necessity at the present time is that available scientific information should be used to the fullest advantage. It is only by the combination of scientific investigation with the practical experience of the pilot and the designer that the best results can be obtained, and the much-desired supremacy of the air definitely assured.

The following officers of the Linnean Society for the ensuing year were elected at the annual meeting of the society on May 24:—*President*, Sir David Prain, C.M.G.; *Treasurer*, Mr. H. W. Monckton; *Secretaries*, Dr. B. Daydon Jackson, Mr. E. S. Goodrich, and Dr. A. B. Rendle.

We regret to see the announcement of the death, on May 28, at seventy years of age, of Sir James F. Goodhart, consulting physician to Guy's Hospital and other institutions, and president of the Harveian Society of London in 1898.

The fourth Wilbur Wright Memorial Lecture of the Aeronautical Society, on "The Life and Work of Wilbur Wright," will be delivered by Mr. Griffith Brewer at the Royal Society of Arts, on Tuesday, June 6, at 3 p.m. The Rt. Hon. Lord Montagu of Beaulieu will preside.

At a meeting of the Institution of Mining Engineers, to be held at the rooms of the Geological Society, Burlington House, Piccadilly, W., on Thursday, June 8, Prof. F. W. Hardwick will deliver a lecture on "The History of the Safety-Lamp," in celebration of the centenary of its invention by George Stephenson and Sir Humphry Davy.

We regret to announce the death, on May 17, at eighty-four years of age, of Mrs. Mary Everest Boole, widow of George Boole, the mathematician. Devoted to her husband and his memory, she was an original and rather paradoxical writer; for example, on the strength of her knowledge of the mathematical theory of envelopes, she wrote a sort of metaphysical essay about free will, etc., in terms of an envelope-theory. Like Henry Drummond, she mistook a picturesque analogy for a real explanation; but the book is better worth reading than many more orthodox productions.

General Sir Douglas Haig, Commander-in-Chief of the British Forces in France and Belgium, in his first despatch, dated May 19, and covering the period from December 19, 1915, makes the following appreciative reference to the assistance afforded by chemists attached to the forces:—"The valuable nature of the work performed by the officers of the Central Laboratory and the Chemical Advisers with the Armies in investigations into the nature of the gases and other new substances used in hostile attacks, and in devising and perfecting means of protecting our troops against them, is deserving of recognition. The efforts of these officers materially contributed to the failure of the Germans in their attack of December 19, 1915, as well as in the various gas attacks since made."

Among the representatives of applied science who have lost their lives in the present war some mention should be made of Capt. Paul Hammond. He was born in Brazil of British parentage, and was educated at Tonbridge School. He studied at the School of Mines at Freiberg, in Saxony, where he graduated as a mining engineer. He was for some time engaged in mineralogical survey work in the south of the State of São Paulo, and afterwards practised as a consulting mining engineer in London. Shortly after the outbreak of war he received a commission in the 8th Battn. of the East Lancashire Regiment, and was Acting Major when he was wounded at Foncquevillers. He died eight days later, on February 25 of the present year, aged thirty-one. His keenness and courage stood him in good stead in his short military career, while his cheerfulness and kindliness endeared him to all who knew him.

A report has just been issued by the Committee appointed by the Home Secretary in March last to test experimentally the value of dry-powder fire-extinguishers in putting out fires such as are likely to be caused by bombs (Cd. 8250, price 1*d*.). These extinguishers generally contain as their main constituent sodium bicarbonate, the amount varying from 46 to 56 per cent. in the samples analysed. The particular make chosen for the fire experiments contained also approximately the same proportion of calcium carbonate, the total available carbon dioxide amounting to 12 or 13 per cent. The efficacy of the dry-powder preparations was compared with that of water applied (1) in buckets, and (2) in liquid extincteurs spraying a jet of water impregnated with carbon dioxide upon the fires. None of the agents employed had any material effect upon the combustion of the bomb itself. Water, however, was far more effective than the dry powder in preventing the spread of the fire, the wetting of the surrounding material confining the conflagration to the immediate neighbourhood of the bomb. The general conclusion arrived at was that by far the best extinguishing agent is a plentiful supply of water applied in the manner most convenient; the use of dry powder is to be deprecated as giving a misleading sense of security.

Some interesting details of his recent explorations in Central Asia have been furnished by Sir Aurel Stein on his return to England. He followed a route hitherto unknown to the Pamirs across Darel and Tangier, and in this portion of his journey he was assisted by Pakhtum Wali, an exiled chief of Chitral, who has recently carved out for himself a new kingdom in this region, and desires the friendly support of the Government of India. At an old sand-buried site in the Talkamakan desert many ancient writings on wood in an early Indian language dating from the third century A.D. were found, and the old route by which the Chinese conveyed their silks to Central Asia and the Mediterranean was traced. On this road hundreds of copper coins and bronze arrow-heads, the débris of their caravans, were picked up. On another

part of the route the watch-towers erected by the Chinese to protect their western marches in Kansu against the Huns were examined. These travels involved more than 11,000 miles marching over mountain and desert, and Sir Aurel Stein gratefully acknowledges the kind treatment he received from the Russian officials. The explorer and the Indian Government, who organised the journey, are to be heartily congratulated on the successful completion of a task which will supply much new information on geography, history, art, and linguistics.

THE provisional programme of the eighty-sixth annual meeting of the British Association, to be held at Newcastle-upon-Tyne from Tuesday, September 5, to Saturday, September 9, under the presidency of Sir Arthur Evans, F.R.S., is about to be issued. The inaugural meeting will be held in the Town Hall on September 5, at 8.30 p.m., when the president will deliver an address to the association. Evening discourses will be delivered in the Town Hall on Thursday, September 7, by Prof. W. A. Bone, F.R.S., who will deal with some recent advances in combustion, and on Friday, September 8, by Dr. P. Chalmers Mitchell, F.R.S., on "Evolution and the War." The reception-room will be in the College of Medicine. Some of the section-rooms will be in the same building, and the remainder will be conveniently accessible from it. The following are the presidents of sections:—A (Mathematical and Physical Science), Dr. A. N. Whitehead, F.R.S.; B (Chemistry), Prof. G. G. Henderson; C (Geology), Prof. W. S. Boulton; D (Zoology), Prof. E. W. MacBride, F.R.S.; E (Geography), Mr. D. G. Hogarth; F (Economic Science and Statistics), Prof. A. W. Kirkaldy; G (Engineering), Mr. G. G. Stoney; H (Anthropology), Dr. R. R. Marett; I (Physiology), Prof. A. R. Cushny, F.R.S.; K (Botany), Dr. A. B. Rendle, F.R.S.; L (Educational Science), Rev. W. Temple; M (Agriculture), Dr. E. J. Russell.

A VERBATIM report has just been published (London: Harrison and Sons; price 6d.) of the proceedings of the conference on the Neglect of Science, of which an account was given in NATURE of May 11 (p. 230). The conference was successful in eliciting some noteworthy utterances from leading representatives of many departments of national activity, and was fortunate in securing Lord Rayleigh as the chairman. The chief claim of the first resolution was that science "should form part of the entrance examination of the Universities of Oxford and Cambridge, as well as of the newer universities." Lord Rayleigh is Chancellor of the University of Cambridge, which still makes, not science, but Greek an essential subject of entrance examinations; and the purpose of the meeting over which he presided was to urge the need for reform. It is of particular interest, therefore, to give Lord Rayleigh's views upon the supposed advantages of compulsory classical study for the average boy in a public school. "I believe it is true," he said, "there is a certain type of mind for which a classical education on more or less existing lines is perhaps the best thing that can be found; but when it comes to the majority of schoolboys, I think it is nothing less than an absurdity to talk about impressing them with the language and literature of the ancients. It is well known that such a result is not achieved with the average boy. I myself was an average boy, in classical matters anyhow, and I can speak from experience. I was not behind the average; but I know that the long years which I gave to classical work were to a very large extent thrown away, although I have no doubt I got something from it; but any idea of attaining to an appreciation of the language and literature of the Greeks, in my own case, and in the case of most of my friends, was mere moonshine. . . . You pretend to take a literary education by Greek, and you end by getting none at all. My own belief is that modern languages to a very large extent serve the purpose if properly taught and properly insisted upon, as they very frequently are not now."

THE death is announced of Prof. Paul Lemoult in tragic circumstances. Until the outbreak of war he occupied the chair of chemistry at the University of Lille, and was at the same time director of the School of Commerce of the North, and chief engineer to the chemical works of La Pallice, near La Rochelle. When Lille was occupied by the enemy some of the industries were transferred to the Lyons district, and under the direction of Prof. Lemoult a picric acid works was erected, which very soon was able to contribute substantially to the production of this explosive. On Monday, May 1, a fire broke out in the works, and very soon assumed serious proportions. Lemoult was soon on the spot, but, in spite of his efforts, the fire spread to the storehouse, which contained 150 tons of picric acid. The explosion which ensued destroyed the factory, and Lemoult lost his life. Paul Lemoult was born in 1871, and after passing through the Lyceum at Poitiers he was admitted to the Ecole Normale in 1891. He then entered the laboratory of Berthelot as *préparateur*. He obtained his doctorate in 1898 for a thesis on the polymerisation of cyanogen compounds, for which he obtained the Jérôme Ponti prize. He afterwards took a post at the celebrated colour factory of St. Denis, where he remained several years, when he was appointed to the University of Lille. His wide knowledge of technical matters was greatly valued by the industrial community among which he lived, and the confidence which he inspired led to his appointment as director of the School of Commerce of the North. He made several valuable contributions on organic chemistry to the *Comptes rendus* of the Paris Academy of Sciences.

IN 1879 the arrangements for the transport of the obelisk from Alexandria to New York were undertaken by the Government of the United States. The work was completed, and the obelisk was erected at New York in October, 1879. During the course of the operations Lieut.-Commander H. H. Gorringe, who was in command of the expedition, made a collection of Egyptian antiquities, which were removed to America, but after his death the collection was completely lost to sight, and has only recently been examined by Prof. S. A. B. Mercer, who gives an account of it in part ii. (1916) of *Ancient Egypt*. It turns out to be of exceptional interest, containing a number of fine terra-cotta figurines of Harpocrates and Isis, dating from the Roman period. The gems of the collection are a beautiful bronze figure of Ptolemy Lathyros, an excellent example of Ptolemaic art; a number of bronze figurines of the Roman period, and statues of Osiris, Sekhmet, Neith, and Isis of the twenty-sixth dynasty. In the same issue of *Ancient Egypt* Prof. C. G. Seligman describes a remarkable ivory comb of the prehistoric period, with a representation of the hippopotamus goddess, Taurt, which seems to be the earliest representation of this divinity, and indicates that her cult prevailed in a time earlier than is usually supposed.

THE visit of the British Association to Winnipeg in 1909 gave a welcome stimulus to ethnographic work in Canada, of which an account is given by Mr. A. C. Breton in *Man* for April. The Dominion Government has contributed liberally to this work by establishing an Anthropological Division of the Geological Survey,

with charge of the Victoria Memorial Museum at Ottawa as the centre of research, and it has already published a series of papers of exceptional value. Canada possesses at the present time no fewer than thirty museums equipped with anthropological departments, the most important being that at Ottawa. In this the complete Labrador Eskimo ethnological and archæological departments are of special interest. Toronto possesses the cranial collection of the late Sir D. Wilson, and a fine series of skeletons from mounds in Ontario and Manitoba, brought together by Prof. Montgomery. In the Provincial Museum in the same city are stored collections of Ontario skulls and a mass of stone implements brought from ancient sites in the province by the late Dr. David Boyle. A good example of a local museum is that of the Rocky Mountains Park at Banff, where Mr. Harlan Smith is in charge of fine collections from the tribes of that region. The Dominion Government deserves warm congratulations for the active interest it has shown in developing the study of the ethnology and archæology of the country.

THE *Annals of Tropical Medicine and Parasitology*, vol. x., No. 1, April, contains six papers. Dr. H. H. Scott deals with the vomiting sickness of Jamaica; Dr. G. Duncan Whyte with simplified diagnosis and treatment of ancylostomiasis; Dr. E. R. Armstrong with differential blood counts in malaria; Mr. H. F. Carter with three new African midges; Sir Leonard Rogers with the reduction of the alkalinity of the blood in cholera; and Dr. H. R. Carter, of U.S.A., with immunity to yellow fever. Dr. Scott, who is Government bacteriologist in Jamaica, after a long and careful study, concludes that vomiting sickness, so prevalent in that island, is due to poisoning by ackee fruit, *Blighia sapida*. There has been much difference of opinion as to the causation of this vomiting sickness, yellow fever and cerebro-spinal meningitis having been considered to be the cause of death in many of the cases in the past. Dr. Scott found in 1914–15 that ackees formed part of the last meal taken in health before the onset of the disease. Persons taking the "soup," or "pot-water," made with ackees in certain conditions, showed the most acute symptoms; the onset occurred in two hours, and death nearly always resulted. Unopened ackees, those picked from a decayed, bruised, or broken branch, those forced open unnaturally, and those with a soft spot are poisonous. Much of the poison is extracted by boiling with water. The affection is largely one of childhood. By experiment it was determined that intragastric administration of an extract, made by boiling unopened ackees with water, produced in three kittens and one pup the symptoms and pathological changes seen in cases of vomiting sickness. The pathological changes in man and experimental animals are described, and are well illustrated in two plates.

IN the *American Naturalist* for April Prof. T. Waterman discusses the evolution of the human chin. His main object is to demonstrate the fallacy of the contention of Dr. Robinson that the human "chin" has evolved as a consequence of the habit of articulate speech. Prof. Waterman's task is not difficult, but his essay serves a very useful purpose, and his facts are admirably marshalled. It might, however, have been pointed out that the evolution of the chin is due as much to the shortening of the facial portion of the skull as to the reduction of the teeth.

THE *Museum Journal* of Philadelphia for December has just reached us. Among other items of interest, it contains a very readable account of the Eskimo of Coronation Gulf, known also as the "Copper" Eskimo, from the fact that these people are largely dependent on this metal for their implements. It is among them that Stefansson found his "blond Eskimo." The clothing, weapons, and methods of hunting are described at length, but no description of the physical characters of these people is given. Copper appears to be the only native metal they possess, but they also use iron and brass, though only to a very limited extent. How, and whence, they obtain these is not stated.

MR. HALSEY BAGG, in the *American Naturalist* for April, records the results of his recent attempts to measure individual differences in behaviour in white mice, and therefrom to determine the degree to which kinds of conduct can be established in family lines by selection. His choice of white mice, in preference to man, he explains, was determined by the fact that in man the experimental method cannot be used. Mr. Bagg's test of alertness and educability was made through the medium of a maze ending in a food compartment. Altogether ninety mice were used, and each individual was passed through the maze seventeen times. There were no marked differences between the sexes in regard to this test of ability, but yellow mice proved inferior to white in this ordeal. The author found marked individual differences in behaviour, and discovers an apparent resemblance among individuals of the same litter.

AN interesting point in relation to the geographical distribution of British Mollusca will be found in the *Scottish Naturalist* for May. Therein Mr. Denison Roebuck reviews the history of a slug, *Limax tenellus*, found by the Rev. R. Godfrey, in the Rothiemurchus Forest in 1904, after it had been lost sight of for fifty-six years. Some were obtained from under stones, but the majority were taken from old pine branches covered with decayed pine needles and other rotten vegetation. This discovery of the nature of the habitat at once threw a flood of light upon the occurrence of the species, and showed that the reason it had so long escaped notice was due to this preference for aboriginal pine forests, an area conchologists had never thought of searching, from a belief that pine was inimical to molluscan life. The clue obtained, search was at once made on an extended scale, with the result that it has since been found in no fewer than six Scottish and eleven English counties, five of these forming a ring encircling London. But, more than this, it occurs in abundance in the pine forests of Switzerland, and it now remains to discover the intermediate stations on the mainland of Europe.

MESSRS. SHERRATT AND HUGHES, Manchester, have published a further account, by Mr. J. Arthur Hutton, of investigations into the salmon fisheries of the River Wye. Good statistics of the fish caught by rods and nets, and measurements and determinations of age are given, and the author deduces some very interesting results. The scarcity in very large spring and summer salmon (five and a half to six years old) indicates an apparent failure of the 1910 hatch, and this appears to be traceable to two causes:—(1) The exceptional drought and high temperature in the rivers in the summer of 1911, which probably encouraged coarse fish in competition with the early stages of salmon; (2) the marine conditions in 1912, the year when the parr hatched in 1910 would migrate to the sea. This was a season of high salinity in the sea, and of low autumn temperature. A further point brought out by Mr. Hutton is that Wye salmon have for some years been migrating and spawning earlier than usual. This is possibly an integrative effect of a series of exceptionally mild winters. The change is probably only temporary.

ORANGES and lemons in which the style is persistent up to maturity are known to occur at certain seasons and in certain localities, and various theories have been advanced to account for the fact, some writers suggesting that these forms are peculiarities of a distinct variety of the plant. In a note contributed to the *Atti dei Lincei,* xxv. (1), 3, R. Pirotta dissents from these views, and advances the theory that the persistence or otherwise of the style depends on the effects of weather in retarding or accelerating the processes of fertilisation and the ripening of the fruits.

OWING to the scarcity of dyestuffs resulting from the war, considerable interest attaches to the attempts to obtain and utilise new colouring matters. In this connection the *Atti dei Lincei,* xxv. (1), 5, contains an account of investigations by R. Lepetit and C. Carta Satta on the yellow substance extracted from the bark of *Pinus pinaster*. These researches, commenced ten years ago, show that this colouring matter furnishes tints of a beautiful yellow with mordants of alum, of an orange colour with tin, of a less bright yellow with chromium, dirty yellow with copper, and olive-brown with iron. It is thus identifiable with quercetin, and exists in the bark of the fir-tree in a state of complete combination with a tanno-glucoside.

THE report of the Botanic Gardens and Government Domains, Sydney, New South Wales, has just been received, and contains an interesting account of the various botanical activities undertaken under the direction of Mr. J. H. Maiden. In addition, the report includes a valuable contribution relating to the Arachnida, Myriapoda, and Insecta of the Botanic Gardens, by Mr. Rainbow, entomologist of the Australian Museum, and is on similar lines to the account of the mammals, birds, reptiles, fishes, and shells published in the report of the previous year. A long list is given of interesting plants introduced, or re-introduced, into the Gardens, and in the herbarium report we note that 2725 sheets have been added to the collection, many being additions to the flora of New South Wales.

THE report of the Agricultural Department and Experiment Station in the Virgin Islands for the year ended March, 1915, has recently reached us, and shows that considerable attention has been given to the cotton crop, especially with regard to establishing a local seed supply, and thus ensuring uniformity of crop and staple. Coconut planting in the islands is being encouraged, and nearly 3000 nuts were distributed during the year. An Onion Growers' Association has also been formed with every prospect of success. A similar association has been formed in Antigua, where conditions are also favourable for this crop. From the reports of the various islands, it is clear that the Imperial Department of Agriculture is making every effort to extend the scope and foster the progress of agriculture in the West Indies.

IN the course of the voyage of the *Carnegie* from New Zealand to South Georgia last December and January search was made for the Nimrod and Dougherty Islands in the South Pacific. The search in both cases was fruitless. In the *Geographical Review* for April (vol. i., No. 4), where an account of the search appears, it is suggested that the result of this work is to remove these islands, especially Dougherty Island, from the map. The writer is perhaps not aware that in 1909, on the homeward voyage of the *Nimrod,* with Sir E. H. Shackleton's Antarctic Expedition, Capt. J. K. Davis made a thorough search for these islands, and failed to find them. They were in consequence removed from the last edition of the Prince of Monaco's bathymetrical chart of the oceans. Without a doubt icebergs gave rise to the reports of the islands, for it is very difficult in certain conditions of light to distinguish some icebergs from land.

DURING the last year or two the *Geographical Journal* has been devoting some attention to articles on different regions, more or less affected by the war, each from the pen of an expert. In the issue for May, 1916 (vol. xlvii., No. 5), Prof. J. W. Gregory has a long article, illustrated with maps, on Cyrenaica. Prof. Gregory deals particularly with the economic possibilities of Cyrenaica and its future as a colony. Over this he is not enthusiastic, but at the same time is strongly opposed to the view that Cyrenaica is a useless desert. The climatic question is an important one, and Prof. Gregory holds that the evidence points to no change since classical times; nor will he admit that Turkish control has been altogether bad for the land. The change in the economic value of Cyrenaica since Roman times he holds is due mainly to competition by new lands, making the production of corn and wool less profitable, and to honey, a valuable product in the past, being superseded by sugar-cane and beetroot. The decline in the trans-Saharan trade, owing to its diversion to Nile and Niger routes, and the development of steam navigation on the Mediterranean have robbed the country of its position on several great trade routes.

IN connection with the *Daily Weather Report* the Meteorological Office has issued a revised edition of the quinquennial appendix, giving normal values for pressure, temperature, and bright sunshine. The values are extended to include the year 1915, and with the increased length of period are becoming of greater value. Pressure normals for the hour of the reports are now for ten years instead of five, while the normals for air temperature, rainfall, and bright sunshine are for thirty-five years, from 1881 to 1915. The values are given for the several months, and are issued in quarterly sheets. Normals for the current season show only slight differences of pressure, the values being relatively lower in the north and west than in the south and east. Temperature is rising briskly, and in the late spring and early summer the mean daily maximum is about 10° warmer in the south of England than in Scotland, and the mean night temperature shows an almost equally large difference. Rainfall is increasing somewhat at the English stations, while the duration of bright sunshine is at about its maximum.

ACCORDING to a short note in the *Atti dei Lincei,* xxv. (1), 5, containing the Proceedings for March 5, it would appear that piracy of mathematical discoveries was common in Italy in early times. In this note the writer, Prof. Gino Loria, discusses the claims of a work by Luca Pacioli (1445–1514), entitled "Divina Proportione," dealing with mensuration of plane and solid figures, and gives evidence in support of the view that the substance of this work was purloined from an unpublished manuscript by Pier della Francesca entitled "De corporibus regularibus." That Tartaglia's solution of the cubic equation should have become wrongly attributed to Cardan would appear to be the result of a practice of which Tartaglia himself was not altogether innocent. A second part of Prof. Gino Loria's communication deals with some interesting writings by Tommaso Ceva (1648–1737) and Guido Grandi (1671–1737) on the properties of certain curves traced on the surfaces of cones and cylinders. These investigations anticipate Monge's descriptive geometry, inasmuch as the method of projection was used in studying the curves in question. Ceva discussed the properties of the curve which pro-

jects into a spiral of Archimedes, and Grandi applied the same method to the curve of which the projection is an equiangular spiral.

THE October-November part and the December (1914) part of the *Journal de Physique*, which were published in the earlier part of May, complete vol. iv. of the journal. Amongst the longer papers contained in the two parts may be mentioned one by Prof. Marcel Brillouin on kinetic energy and absolute temperature in isotropic solids, the concluding portion of Prof. Seligman-Lui's paper on the mechanical interpretation of the law of gravitation, Prof. Gouré de Villemontée's paper on the propagation of electricity through paraffin oil, and Prof. E. Bouty's paper on some examples of the application of the method of closed cycles. In addition, there are shorter papers on the localisation of foreign bodies in the organism by radiographs, and on the recent determination of the latent heat of fusion of ice at the Bureau of Standards at Washington. The abstracts of papers published in other journals include a number in the *Philosophical Magazine*, *Journal de Chimie-physique*, *Annalen der Physik*, *Physikalische Zeitschrift*, and the *Zeitschrift für Physikalische Chemie*. The author index of the volume covers twenty, the analytical table of contents sixteen, and the volume 850 pages.

MR. A. L. PARSON has published a novel theory of the constitution of atoms based on a new conception of the structure of the electron ("A Magneton Theory of the Structure of the Atom," Smithsonian Miscellaneous Collections," vol. lxv., No. 11). Instead of the usual assumption that the electron possesses spherical symmetry, the author considers it to be a ring of negative electrification revolving with high speed. The diameter of the ring is supposed to be of the same order of magnitude as atomic diameters, and the tangential velocity of revolution to be about the velocity of light. The author points out that these assumptions are not inconsistent with the experiments on which our knowledge of the electron is based, and shows that they offer a mode of escape from certain well-known difficulties in all theories of atomic structure based on the usual assumptions of simple electrons. In the paper the application of the new conception to the explanation of the chemical and magnetic properties of the elements is discussed at considerable length, but it may be noted that all the considerations are only of a qualitative character, and do not provide any definite test of the adequacy of the theory. It should be added that no use is made of the recent valuable and extensive evidence as to the structure of atoms derived from the study of the phenomena of radio-activity and X-rays, and, indeed, it seems difficult to account for them on the new theory.

MR. F. C. THOMPSON, in a paper recently read before the Faraday Society, directs attention to the fact that, almost without exception, alloys which are of industrial utility consist of one or more solid solutions. The brasses, nearly all the bronzes, the nickel brasses, most coinage alloys, aluminium alloys for aeroplane and motor-car construction, fall within this category. The hardening of steel is due to the formation, and more or less complete preservation on quenching, of a solid solution. The special properties of the nickel and nickel chromium steels are due to the improvement conferred by the alloying element or elements which dissolve in the iron. The dominating characteristic of these alloys as compared with the pure metals from which they are made is "toughness," a combination of strength and ductility. As a result of his study of the matter, Mr. Thompson concludes that the remarkable hardness and high electrical resistivity of solid solutions of metals point strongly to the fact that they are caused by crystalline distortion similar to that which arises from cold work. This is explained on the theory that the process of crystallisation of such solutions causes an equalisation of the atomic volumes of the constituents. Elastic stresses are thus set up which, in their turn, increasing the resistance to further stresses, raise the hardness of the mass. Such a theory would lead to a parabolic curve expressing the relationship of the hardness to the concentration throughout the series, with a maximum at the composition of 50 atomic per cent. of each metal. The silver-gold series of alloys fits into this generalisation.

TECHNOLOGIC PAPER No 68 of the U.S. Bureau of Standards deals with standardisation of automobile tyre fabric testing. The chief causes of variation in test results are due to different testing machines, dimensions of test specimens, moisture content of specimen at time of test, method of sampling, and lack of uniformity in the material. There is but little difference in the results for strips of 1 in. and 2 in. width, and the former width has advantages which indicate that preference should be given to it. The fabrics were supposed to contain twenty-three threads per inch, and the actual width of the specimens was fixed by counting twenty-three threads. The average strength of thirty tests on 1-in. specimens was 247 lb. Samples of cotton material increase in strength considerably when they have absorbed moisture from the atmosphere. It is best to dry the sample in such a way as to eliminate moisture effects entirely. There are only small differences in strength for specimens selected from different parts of the width of the fabric; samples should be cut from different parts, and the average result taken. Tests made in different machines show differences amounting to as much as 15·9 per cent. It is recommended that testing machines be calibrated at frequent and regular intervals.

OUR ASTRONOMICAL COLUMN.

LARGE DAYLIGHT FIREBALL ON MAY 20.—Mr. Denning writes:—"On May 20, at 8.8 p.m. (18 minutes after sunset, Greenwich), a splendid meteor was seen by a great many persons in the southern counties of England. The sky was clear everywhere, and the large green disc of the meteor created a vivid effect as it passed with a rather slow, apparent motion from N. to S. across the western heavens. Reports from fifty-six casual observers of the phenomenon have been received, and it appears from a preliminary discussion of the data that the object was directed from a radiant in Perseus situated in the N.N.W. sky at the time of the event. The height of the meteor was from about 75 to 27 miles along a course, slightly declining in height, of more than 200 miles. The position was from over the S.E. coast of Ireland to the English Channel, far south of Devonshire.

"The estimates of the observed duration of flight of the meteor are rather conflicting, but, taking a mean of what appear to be the best values, the real velocity was about 32 miles per second.

"This fine meteor adds another instance to the rather extensive list of similar objects which have made their apparitions in twilight. The hour following sunset is highly favourable in some respects to the production of these objects, though the prevailing daylight must naturally cause many of them to elude notice."

COMET 1916*b* (WOLF), 1916 ZK (PLANET).—From *Astronomische Nachrichten*, No. 4845, we learn that observations of the anomalous object 1916 ZK, discovered

by Wolf, were made at Vienna on April 6, 7, 22, and 27. On the latest date Dr. Palisa observed a sort of halo surrounding its image, and further remarked that the change of daily motion was not asteroidal in character. In America it has been observed at Yerkes (May 4) and at the U.S. Naval Observatory (May 6). It is shown on photographs taken at Bergedorf on April 29 and May 2; on the earlier date its magnitude was 13·2. According to observations by Prof. Wolf (April 30) the nebulosity was 15″ in diameter, and sharply defined towards the W.N.W., the nucleus being eccentrically placed in the same direction, thus presenting features justifying its classification with comets. The cometary character is emphasised by the Babelsberg observers, who state that it is immediately picked up as a comet. Observations, April 6–May 6, have been used by Prof. Berberich in an investigation of the orbit assuming motion approximately following a great circle, but no useful results had been obtained. The middle-place errors for a parabola (April 6 and 22, Vienna, and May 6, Babelsberg) are stated to be inadmissibly large. A provisional ephemeris based on hyperbolic elements (April 6, 22, and 30) represented fairly closely the Babelsberg observation of May 6.

The following orbit and ephemeris have been calculated, also by Prof. Berberich (*Astronomische Nachrichten*, Circular No. 508), by variation of the distance-ratios from the observations of April 6, 22, and May 6 referred to above:—Perihelion = 1917, June 15·916 G.M.T.; $\omega = 120^\circ\ 30'\ 19{\cdot}3''$; $\Omega = 183^\circ\ 15'\ 12{\cdot}6''$; $i = 25^\circ\ 35'\ 21{\cdot}9''$; $\log q = 0{\cdot}227854$.

Ephemeris, Greenwich Midnight.

	R.A. h. m. s.	Decl. ° ′
June 1	12 29 7	+4 28·5
5	12 28 46	4 35·0
9	12 28 38	4 39·9
13	12 28 43	4 43·3
17	12 29 0	4 45·1

The orbit can still be somewhat uncertain, but the ephemeris should suffice very well for search. Perihelion passage, it should be noted, occurs in the middle of June of next year, so that comet 1916*b* promises to be under observation for a very extended period. At present the distance from the earth is increasing. On July 3 it will be, roughly, 0·44 astronomical unit—40 million miles—from both the earth and the sun.

A POSSIBLE NEW COMET.—The following message from Prof. Pickering was received on May 8 at Kiel: "Perrine cables bright object Thursday evening, nine to ten, moved ten degrees alpha Pavonis towards sun. Possibly comet" (*Astronomische Nachrichten*, No. 4845).

VENUS.—On June 3, two days after maximum brilliance, Venus will be in conjunction with the moon; the planet will be 1° 19′ N. Unless clouds prevail this configuration will afford an excellent opportunity of viewing the planet in full daylight without optical help. Although the crescent phase can now be distinguished with quite small hand telescopes, the most interesting phenomena of the phases—the more or less complete annulus seen at inferior conjunction with the sun (July 3) and the secondary light, "lumière cendrée"—are only to be seen with large instruments. As inferior conjunction occurs at 8h. G.M.T., English observers will be at a disadvantage. Recent work indicates that a period of sun-spot maximum is specially favourable for the development of luminous effects on the dark side of the planet, but there is a dearth of observations, and it is desirable that a close watch should be maintained.

METEOROLOGICAL AND MAGNETIC AUTOGRAPHS.[1]

COMPLAINT has been made from time to time of the essential dulness of year-books of tabular matter, although it is recognised that the statistics must be compiled diligently year by year in order to provide material for exhaustive discussion at some time in the future. It is, therefore, all the more gratifying to find in the Blue-book before us, published by the authority of the Meteorological Committee, and produced under the direction of Sir Napier Shaw, a definite attempt made to digest the magnetic data obtained in 1913 at Eskdalemuir, somewhat on lines suggested by Prof. Birkeland and also by Dr. Chree.

Mr. L. S. Richardson, who contributes this analysis of magnetic disturbances recorded at Eskdalemuir Observatory, of which he was appointed director in 1913, is also responsible for an appendix giving indirect comparisons by means of a standard set of portable magnetic instruments, between the standard instruments in use at Greenwich, Kew, Falmouth, Valencia, and Eskdalemuir in the United Kingdom, and also those at De Bilt (Utrecht), Potsdam, and Val Joyeux, the national magnetic observatories of Holland, Germany, and France, thus partially anticipating the comparisons made recently under the auspices of the Carnegie Institution.

Mr. Richardson gives two classes of magnetic disturbance, whereas Prof. Birkeland indicated three, but one of the three was an intermediate class, so perhaps, in general, two will be sufficient, the essential difference being that in one class the direction of the disturbance is constant and in the other variable. In connection with the well-known smoothness of the vertical force traces as compared with the other magnetograms, Mr. Richardson makes a suggestion worthy of attention. He says:—"The fact that the vertical component is perpendicular to two electrically-conducting shells, the earth's surface and the upper ionised air, may have an influence in reducing the amplitude of its oscillations. For an oscillating current forcibly maintained in either shell would induce a reverse current in the other shell; and at an observatory which was not more than a small arc of the earth's surface away from the currents, the reverse current, while partly neutralising the vertical force, would increase the horizontal component. For slower oscillations the induced current would be diminished by the electric resistance. The system is like a transformer with a short-circuited secondary coil. The vertical force is the main flux of the transformer. The horizontal components represent the magnetic leakage."

The magnetic data from Eskdalemuir form the principal part of the magnetic portion of the Year Book, the Kew data being given in much less detail, Valencia being unprovided with magnetographs, and Falmouth practically discontinued. Meteorology is represented by five stations, Aberdeen being the additional contributor, monthly means for each hour of the day being tabulated for temperature, pressure, and relative humidity of the air, for wind velocity, and rainfall, sunshine tables being added.

It is curious to note that the mean warmest hour at Falmouth is invariably 1 p.m., while at the other observatories it is generally 2 p.m. or 3 p.m. The arrangement of the tables is that, except for Eskdalemuir, the establishment of which is too recent for normals to have any significance, what is printed is a

[1] Meteorological Office. British Meteorological and Magnetic Year Book, 1913. Part iv., section 2. Hourly Values from Autographic Records. Pp. 97. (Edinburgh: H.M.S.O.; London: Meteorological Office, 1915. Price 5s.

set of normal values and the departures for 1913. It is doubtful if this is more convenient than the old plan of publishing current values and departures from normal. A brief comparison between the extremes for Kew and Greenwich for 1913 indicates that there is less close agreement than might be expected, showing that for London as a whole one outlying station is totally inadequate. We notice the employment of the millibar in the pressure tables, and also of absolute temperatures, but neither of these is likely to popularise the work, but if the aim be uniformity we might suggest that a step in this direction might be made by adopting a uniform height above the ground for corresponding instruments, especially for the thermographs, which are all at different heights.

W. W. B.

RESEARCHES ON HOPS.

IN a contribution to these pages a couple of years ago (NATURE, April 23, 1914, vol. xciii., p. 199) it was pointed out that a good instance of that scientific attention which is paid by certain foreign countries to the study of economic plants could be seen in the monographic study of the hop which is being made by Dr. J. Schmidt, with his staff of chemists and botanists, at the Carlsberg Laboratory, Copenhagen. In that review the results were noted of Dr. Schmidt's investigations into the growth in length and rotational movement of the stem of the hop and their diurnal periodicity. We have now to hand the results of a number of further researches.[1]

Dr. O. Winge has investigated the pollination and fertilisation processes in *H. Lupulus and H. japonicus.* The paper deals fully with the cytological and nuclear phenomena, and is clearly illustrated by figures. Some interesting developmental points were observed in the study of a monœcious hop and of a sterile gynomorphous male. Experiments to produce a hybrid between *H. Lupulus* and *H. japonicus* failed; it may be observed here that the same negative results were obtained by the reviewer three years ago. Dr. Winge's investigations showed that the pollen of *H. japonicus* caused the ovary of *H. Lupulus* to swell almost to the normal size, resulting ultimately in a "fruit" of normal appearance. The hop strobile, too, developed its axis and stipules. Microscopical examination showed that as a rule fertilisation had taken place in the embryo-sac, and a small embryo was produced, which, however, never developed further. Dr. Winge thinks that it is perhaps possible that the pollen of Urtica may be able to produce "fruits" in the hops in hop-gardens, as was asserted by a practical man—a Bavarian hop-grower—in 1883.

Dr. H. Schjerning gives a full summary of his numerous researches dealing with the proteid substances of barley, both in the grain itself and during the brewing processes; for reasons of space, no further reference can be made to this here.

A new method for the quantitative determination of resins in hops is described by Messrs. O. Winge and J. P. H. Jensen. These investigators found that, contrary to what Hayduck has stated, the γ resin is of value to the brewer, since it gives a bitter taste to the wort and helps in the precipitation of the albumens. For the determination of the total resins in the hop the most satisfactory method was found to be that of extraction with cold ethyl ether and titration of the solution with 1/20 normal potassium hydroxide solution. By this method the lupulin content is obtained as a percentage of the dry weight of the hops; it has been employed not only for the valuation of the various varieties of hops grown in the experimental garden, but also in analyses of trade samples made by the laboratory in co-operation with various breweries. The relations between the bitterness of the α, β, and γ resins were found to be constant, and, respectively, as 10 : 7 : 4.

Dr. J. Schmidt has a very interesting paper on the aroma of hops. The author does not regard it as proved that the aroma present in a hop sample, when this is mixed with the wort for boiling, has any decisive influence on the flavour of the beer. This, it may be noted, is in opposition to the view held by brewing experts, and the further information on this subject which Dr. Schmidt promises will be awaited with interest. It is pointed out that the commercial varieties of cultivated hops are very probably not "true," since, being propagated by cuttings, there is always the danger that these may be taken occasionally from seedlings which have established themselves in the garden. To avoid the danger, Dr. Schmidt has used exclusively at his research station individuals raised by vegetative propagation from one plant. This group of individuals is termed a hop-clone—a clone-plant being any single plant belonging to the clone. In crossing experiments with two American varieties and Danish male hops, proof was obtained that the distinctive aroma of these American hops—which Dr. Schmidt calls "turpentine-like"—was transmitted to between half and three-quarters of the offspring plants, without regard to whether the hops (strobiles) themselves retained the appearance peculiar to those of the mother plant. It is to be hoped that Dr. Schmidt will be on his guard against attempting to ascertain the true nature of the aroma of a new seedling hop from the examination of the plant in its early years exclusively, since there is reason to believe that this may change with the age of the plant.

Dr. Schmidt also records the results of his investigations as to the amount of lupulin in plants raised by crossing, and also their time of flowering. It was found that the average lupulin content of the offspring shows (with rare exceptions) a decrease, due perhaps to the fact that the "wild" male plants used were genotypically of a low order as regards lupulin content; in every group, however, some few specimens—the extreme plus variates—occurred; a stock of any of these new varieties with increased lupulin-content can be raised for commercial use by vegetative propagation. Very similar results have been obtained at Wye College, Kent, in the breeding of new varieties of hops; Dr. Schmidt, referring to these, writes:—"Altogether, these two series of investigations carried out independently in England and Denmark respectively exhibit remarkable uniformity of results, and the discoveries thus made appear to promise well for the systematic improvement of hops."

E. S. S.

[1] "Comptes Rendus des Travaux du Laboratoire de Carlsberg," vol. xi. livr. 1–4 (1914–15).

"TROPISMS."

THE word "tropism," first used to indicate the growth-direction of plant-members under the influence of some stimulus, has during the last fifteen years become a favourite term among investigators of the behaviour of animals. Those interested in physiological terminology will find accounts of the various meanings attached by different writers to the word in two controversial articles by Mr. S. O. Mast (*Arch. f. Entwicklungsmechanik*, xli., 1914, pp. 251–263, and *Biol. Centralbl.*, xxxiv., 1914, pp. 641–674). He finds that the word is now "used in so many different senses that everyone finds it necessary to indicate in which sense he proposes to use it"; there-

fore the author suggests that it might advantageously be dropped in favour of such well-understood expressions as "reaction" or "orientation." It is satisfactory to find that he repudiates the endowment of the term "with mystical causal powers." By calling a reaction—say to light—a "tropism," one does nothing to explain it.

In his recent important work on the Foraminifera, Mr. E. Heron-Allen has directed attention to the purposeful behaviour shown by many of these Protozoa in the selection and arrangement of foreign materials worked into their tests. He sums up the evidence on this subject in a paper in the Journ. R. Microsc. Soc., vol. xvi., part 6, and concludes "that there appears to be no organism in the animal kingdom, however simple be its structure, which lives a life of its own independently of any other organism, which is not capable of developing functions and behaviour . . . which in the Metazoa might be called, and would properly be so called, Phenomena of Purpose and Intelligence."

Turning from protozoa to insects, Mr. F. M. Howlett publishes (Bull. Entom. Research, vi., part 3, 1915) some puzzling observations on the chemical reactions of fruit-flies. In the genus Dacus, the males and not the females of certain species are strongly attracted by different eugenol-compounds, the smell of which resembles that emitted by plants that also attract the male flies. The corresponding females do not apparently emit similar odours, nor were they seen to frequent the odoriferous plants. Of the possible explanations suggested by Mr. Howlett, the most probable therefore seems to be that the smells are characteristic of some food which is attractive to males only.

STUDIES IN MENDELISM.

An important paper on the inheritance of the flowering time in peas and rice, by Yuzo Hoshino, has been published in the Journal of the College of Agriculture (Imp. Univ. Sapporo, Japan, vol. vi., part ix.). The author concludes that in peas the inheritance is governed by two pairs of Mendelian factors. In the one pair are lateness (dominant) and earliness (recessive); in the other pair are acceleration (dominant, hypostatic to lateness) and retardation (recessive, hypostatic to earliness). Gametic coupling between flowering time and flowering colour is also indicated, early red and late white flowers being equal in number and far fewer than early whites or late reds. The experiments on rice were not conclusive, but the author suggests that three pairs of Mendelian factors are probably concerned.

In the Proc. Amer. Phil. Soc. (vol. liv., No. 218) Bradley M. Davis discusses from the Mendelian point of view the mutation phenomena in Œnothera, and advises caution in accepting results based on breeding experiments where there is reasonable doubt as to the gametic purity of the parent "species."

The March number of the *Journal of Genetics* (vol. v., No. 3) contains several papers of interest. Misses C. Pellew and F. M. Durham find that from reciprocal crosses between *Primula verticillata* and *P. floribunda* plants resembling the female parent are generally obtained, these breeding true to type when self-fertilised. Occasionally the hybrids are of the *P. Kewensis* form, some partially sterile and others fertile. J. V. Eyre and G. Smith discuss some results from the cross-pollination of varieties of flax. W. Neilson Jones and Dr. M. Chevely Rayner contribute some important results from breeding experiments with two varieties of *Bryonia dioica*. The presence of waxy bloom on the ripe berry is a recessive character; the capacity to increase the number of vascular bundles in the stem beyond ten "behaves as a simple dominant to the absence of such capacity." The authors consider that their experiments "emphasise the need for caution in the subdivision of existing species without recourse to breeding tests." A supplement to Dr. L. Doncaster's well-known researches on the magpie moth (*Abraxas grossulariata*) is afforded by the Rev. J. M. Woodlock, who discovered near Dublin a new variety of the moth, resembling *lacticolor* in pattern, but behaving as a simple recessive to typical *grossulariata* without any sex-limiting complication. The typical *grossulariata* pattern depends, according to Father Woodlock, on two dominant characters; the absence of one results in the appearance of *lacticolor*, that of the other in the appearance of the new variety, which the reverend author—perhaps with some reminiscence of literary criticism—proposes to designate as "Q̃."

EFFECT OF TEMPERATURE ON SOILS.

The effect of temperature on some of the most important physical processes in soils has been studied experimentally by Mr. George J. Bouyoucos, of Michigan Agricultural Experiment Station, and his results are published as Technical Bulletin No. 22. Very few problems of this kind have been worked out experimentally. Our knowledge is based almost entirely on deductions from the laws of surface tension, viscosity, and expansion as affected by temperature. It is not surprising that when put to the test of experiment, under the complicated conditions that obtain in soils, these deductions are found wanting. When one-half of a column of soil of uniform moisture content is kept at 20° or 40° C., and the other at 0° C., for eight hours, the percentage of water transferred from the warm to the cold soil increases in all types of soil with rise of moisture content until a certain water content is reached and then falls. The author terms the percentage of moisture at which this maximum transfer occurs, the thermal critical moisture content. The laws of capillarity and viscosity do not by themselves explain this result. Experiments on the movement of water vapour from warm to cold soil through an air space showed that such movement was insignificant under all conditions tested. The conclusion is drawn that the source of water as dew is not derived from the soil vapour, as commonly believed.

The translocation of water from a moist soil at 0° C. to a dry soil at 40° C. is very small. This has a most important bearing on the preservation of soil moisture by mulches. The study of the effect of temperature on the rate of percolation of water in soils showed that the rate of flow increases uniformly with rise of temperature only in the case of sand. In other soils, the rate of flow increases up to about 30°, and then falls. It is suggested that in the latter soils the swelling of colloidal matter closes the channels through which the water flowed. Although other reasons might be put forward to explain this effect, the author's hypothesis agrees with some of the known properties of colloids. Further, when the soil was tested at 20° C., then at 50° C., and again at 20° C., the two readings at 20° C. were not the same. This hysteresis effect is interesting.

The last section of the paper is devoted to the relation of temperature to soil aeration. The rate of flow of air through soil decreases with rise of temperature, and this effect is most marked in soils likely to contain colloidal matter, *e.g.* clays and peat. Although the author is, perhaps, rather too ready to assume that the views commonly held on many of the points arising from his work are inconsistent with his own deductions, this bulletin is a notable contribution to our knowledge of the dynamics of soils.

THE SEARCH FOR NEW COAL-FIELDS IN ENGLAND.[1]

THE search for concealed coal-fields was one of the subjects considered by two Royal Commissions appointed to consider our coal resources. Since the publication of the report of the second Commission, in 1905, much progress had been made both in locating new coalfields and in defining the areas in which concealed coal-fields could not exist. By "visible coal-fields" were meant those areas in which Coal Measures, with or without a covering of superficial materials, cropped out at the surface. These areas alone were shown as coal-fields on geological maps, and to them collieries were at first confined. As the geological knowledge of the country progressed it became clear that the Coal Measures might, and did in certain cases, pass under newer formations, and form "concealed coal-fields." A map was shown on which were distinguished (*a*) areas occupied by formations older than Coal Measures, (*b*) visible coal-fields, (*c*) areas occupied by formations newer than Coal Measures. On the last-named concealed coal-fields, so far as they had been found to exist, and the districts in which the absence of Coal Measures had been proved, were distinguished. Thus the visible coal-fields of Cumberland, Durham with Northumberland, Yorkshire with Nottinghamshire and Derbyshire, Staffordshire, Shropshire, Warwickshire, Leicestershire, and Somerset with Gloucestershire, were all bordered on one side or the other by concealed coal-fields, while in Kent a coal-field not associated with any visible outcrop had been proved to exist. In South Wales, however, there was no more than a trifling part of the coal-field concealed in the sense mentioned above.

On the other hand, the absence of Coal Measures had been proved around the northern and western borders of the Kent coal-field and under London, and thence in a general north-westerly direction through Buckinghamshire, Oxfordshire, and Northamptonshire, towards Warwickshire and Leicestershire. The existence of this barren tract had been proved by a number of borings in and near London and in the counties named, but its limits had not been ascertained. On its north-eastern side rocks older than Coal Measures had been proved at Culford, Lowestoft, and Harwich, rendering the existence of coal under central and eastern Suffolk improbable, though there still remained unexplored a tract extending north-westward through Essex, Bedfordshire, and Rutland. On its south-western side there lay a great area of unexplored ground. The south coast, from Folkestone to Devonshire, and adjacent areas in Sussex, Hampshire, and Dorset, with parts of Devonshire, Somerset, and Wiltshire, were unproved in the sense that no boring had yet reached the base of the Secondary rocks. What these rocks rested upon it was impossible to say, but their thickness was likely to be great near the south coast.

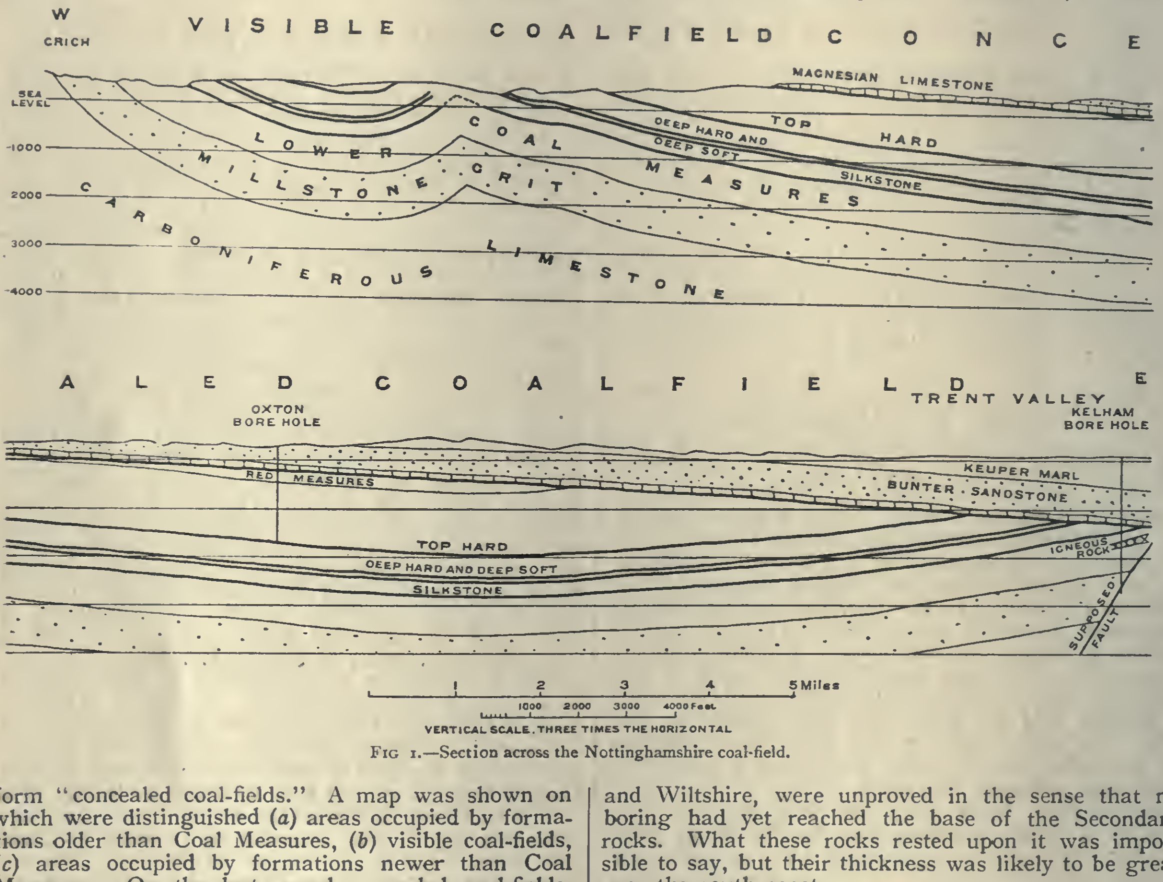

FIG. 1.—Section across the Nottinghamshire coal-field.

Three examples were selected in order to illustrate the nature of the problems which arose in the search for concealed coal-fields.

The Nottinghamshire coal-field was illustrated by a section (Fig. 1) drawn from near Crich, in Derbyshire, to Kelham, near Newark-on-Trent. Commencing in the Carboniferous Limestone, the line of section crossed the visible coal-field in a distance of about 6½ miles. Thus far it was founded on observations made at the surface, but it then entered a region in which Permian (Magnesian) Limestone, Bunter Sandstone, Keuper Sandstone, and Keuper Marl in succession formed the surface of the ground. These formations lay unconformably upon the Coal Measures; they were inclined at a gentler angle, and had not been affected by the folds which had bent the Coal

[1] Abridged from a discourse delivered at the Royal Institution on Friday, March 17, by Dr. A. Strahan, F.R.S.

Measures into synclines and anticlines. It followed that the newer strata were not parallel to the older, and might rest upon any part of the Coal Measures, or even upon any older formation. Surface observations made upon the newer formations gave little clue to the structure of the Coal Measures; reliance had to be placed on boreholes, and on the identification of the specimens obtained from them. The section therefore had been drawn through a borehole at Oxton, and near the Annesley Colliery now working, to a borehole at Kelham.

The Oxton borehole was put down $7\frac{1}{2}$ miles within the margin of the concealed coal-field, and proved that the base of the newer formations had descended eastwards 790 ft. in that distance—that is, at the rate of 1 in 50. The dip of the Coal Measures was rather steeper, and it seemed possible that the coal-field might extend an indefinite distance eastwards, though it might descend to an inaccessible depth.

The Kelham borehole was put down nearly ten miles east of the Oxton borehole, and proved that the eastward dip of the newer formations was maintained at the same gentle angle. At a depth of a little more than 1500 ft. it traversed a seam of coal, the identity of which was in doubt. At about 1700 ft. it passed through a dyke of igneous rock which was of no significance. More important was the fact that down to about 2400 ft. it was in strata which, by their character and fossils, could be identified as Lower Coal Measures, that below them it met little more than 200 ft. of Millstone Grit, and that it then entered Carboniferous Limestone.

The greater part of the Millstone Grit appeared to be cut out by a fault, but whatever explanation was adopted, and whatever the coal-seam might be—whether the Top Hard, as supposed by some, or the Silkstone, as appeared more likely—an eastward rise of the Coal Measures had been proved to exist. The deepest part of the concealed coal-field had been passed, and the eastern limit was in sight.

Similar explorations were being carried on across other parts of the concealed coal-field,[2] and the result had been to show that the eastern limit lay not far east of the valley of the Trent. Though not so large as appeared possible to the Commission of 1905, this extension was a notable addition to the visible coal-field, but its productiveness was still a matter of doubt. Observations on the thickness of coal-seams were difficult in boreholes, but so far the results had been disquieting.

As a second example, the Denbighshire concealed coal-field was selected. Here it was not so much the existence as the accessibility of the coal-seams which was in question, and the reason was found in a great development of upper measures, for the most part barren of good coal. The dip of the strata was much steeper than in Nottinghamshire, and would speedily carry the seams to an inaccessible depth. But the numerous faults tended on the whole to counteract the dip and to keep the seams within reach. The upper measures were distinguishable into three groups, and the recognition of these groups at their outcrops rendered possible estimates of depth to the productive measures below. The results of recent work had been to show that the outcrops were repeated—that is, that the counteraction of dip by faults was continued in the areas not yet proved by underground workings. Nothing was yet known of the area overlain by New Red Sandstone.

The Kent coal-field, the third example selected, was wholly concealed by a blanket of Tertiary and Secondary strata, with an average thickness of 1000 ft. towards the north, but increasing to upwards of 1700 ft. southwards. The structure of the Palæozoic floor upon which this blanket rested had been ascertained by boring. It had been shown that the Coal Measures existed in a syncline formed in the Carboniferous Limestone (Fig. 2). The synclinal axis ranged a little west of north, and the trough became shallower in that direction. Southwards, on the other hand, it deepened and widened, in a manner which suggested that a large part of the coal-field would lie under the sea. The limestone-surface had been reached in so many borings that it had been possible to draw contour-lines upon it, ranging from 1000 ft. to 3500 ft. below sea-level (Fig. 2). These lines showed that the slope of the limestone-surface, though somewhat steeper on the eastern than on the western side of the trough, was generally gentle. The thickness of Coal Measures in part of the trough had been proved to exceed 2700 ft.

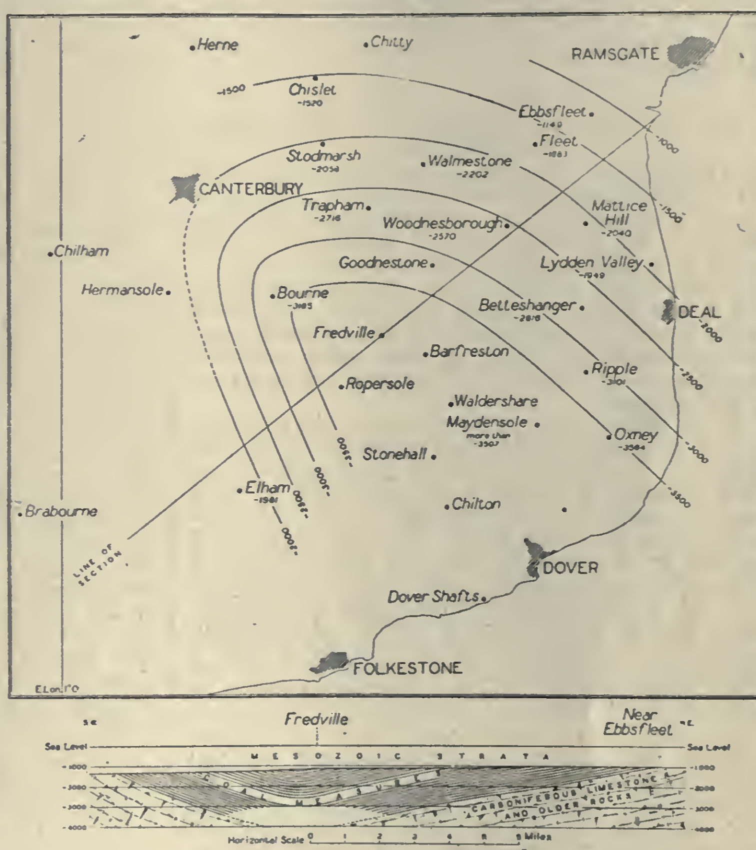

FIG. 2.—Contour-lines in the surface of the Carboniferous Limestone under Kent.

The relations of the Kent coal-field to those of the

[2] An account of the investigation as a whole appears in "The Concealed Coal-field of Yorkshire and Nottinghamshire" (*Mem. Geol. Survey*), 1913.

north of France, Belgium, and South Wales were illustrated by a map. It was shown that the line of intense disturbance on which the Continental coal-fields were situated was more likely to pass south of the Kent coal-field than through it, and that the coal-field occupied a position comparable in this respect to that of the newly discovered coal-field of La Campine. Whether the disturbed belt was continuous under the south of England and joined up with the Armorican folding of South Wales and Somerset could be proved by further borings, and in no other way.

The registration and correct interpretation of borings were matters of great importance. A recommendation made by the Royal Commission on Coal Supplies, that particulars should be collected and preserved in a Government office, had not led to any action. As matters now stood, the records were not only liable to be lost or grossly misinterpreted, but some had gone so far astray as to be accessible only in a German publication.

ELECTRICAL METHODS IN SURGICAL ADVANCE.[1]

NO institution in the world (said Sir James Mackenzie Davidson) had contributed so largely to electrical science as the Royal Institution of Great Britain. All modern electrical developments were based to a greater or less extent upon the work of Michael Faraday and his master, Sir Humphry Davy; and it was fitting, therefore, that in the place which would always be associated with their labours some account should be given of those same electrical developments as applied in the present day to the art of the surgeon.

Before electricity came on the scene the examination of wounded men who had bullets lodged in their tissues was largely dependent on guesswork. As an early instance of the tentative application of more scientific methods, he mentioned the case of Garibaldi, who, after the battle of Aspromonte, was troubled by a wound in the ankle which refused to heal. The presence of an impacted bullet in the foot was not detected until Nélaton, with a whalebone probe having at the end a button of porcelain, managed by introducing it into the wound to make a rubbing contact with whatever it was touching, and found on the tip a black mark caused by the embedded lead.

Such a method in these days would not carry us very far, but since then the discovery of X-rays had come along to revolutionise surgical diagnosis. Sir James gave a description of the production of X-rays with the most modern of tubes—the Coolidge—and then went on to point out that although the shadow picture produced by X-rays gave a good deal of information as to the relative densities of any interposed materials, it was not like an ordinary photograph from which the relative positions of objects could be inferred. It was a shadow of the object, and therefore might be very misleading. He showed on the screen two X-ray pictures of exactly the same subject, in which, however, the tube had occupied slightly different positions. In the one case a bullet appeared to be in the right lung, and in the other in the left. Something more was needed than the single X-ray photograph if any correct information as to the position of a foreign body was to be obtained.

There was, first, the stereoscopic method, and this he illustrated by having two little electric bulbs side by side, one of them surrounded by a green film of gelatine, and the other by a red film, each casting a shadow of an object—a cone of wire—from slightly different points of view. Spectacles consisting of red and of green lenses were distributed among the audience, and when the shadows were viewed through these they combined to give an impression of solidity, as though the actual object were being looked at instead of its shadow. With the spectacles reversed, the effect became a pseudo-stereoscopic one.

This was not precise enough, however, for the purpose of exact localisation, and in order to arrive at mathematical accuracy a different system was available. Here the lecturer gave a description of his own well-known cross-thread localising method, and the manner in which the geometrical conditions under which the two X-ray pictures were produced are reconstructed so as to interpret the various findings on the negative in the terms of exact measurements which the surgeon required to employ. It was really the method of similar triangles. If more rapid procedures were demanded, as they might well be by the exigencies of the present time, the same measurements could be carried out with a hand fluoroscope (shown) and a device consisting of scale, cross wires, and sliding piece, calibrated so as to enable one to determine by the simplest adjustment the depth of a piece of metal below a marked point on the skin by noting the displacement of the shadow on the illuminated screen when the tube was moved to a given distance.

Having ascertained the position of the bullet, other electrical aids were available for the surgeon when he came to deal with its extraction. One of the most useful was the telephone attachment, consisting of a telephone to one terminal of which was attached the surgeon's exploring instrument, and to the other a carbon plate which, moistened with salt water, was applied to the patient's skin. When the exploring instrument came into contact with embedded metals, a loud click was elicited, becoming a sharp rattle on a rubbing contact. A small current, generated when the electrical circuit was completed by contact between the carbon plate and the foreign body, accounted for the microphonic impression. Through the kindness of Mr. Campbell Swinton, who had installed a special loud telephone, the rattling sound, usually heard only by the surgeon when the receiver was close to his ear, was audible all over the theatre. The lecturer also showed the ingenious telephone forceps with X-ray screen attached, adapted by Captain A. E. Barclay, of Manchester.

Another device for the same purpose, largely used in France, was Prof. Bergonié's electromagnet, of which, through the kindness of Dr. Ettie Sayer, the lecturer was able to show an example. In this case a large electromagnet was excited by an alternating current and held over the suspected part. If the magnetic field thus created embraced the embedded projectile, a vibratory motion was induced in the latter, synchronising with the pulsing of the current. The surgeon palpated the part and became instantly aware of any vibration of the tissues which indicated the presence of the metal. The point of maximum vibration having been selected, he made an incision at that point, and then the magnet was again used and the incision deepened in accordance with the information it gave. The lecturer was able to repeat this action on a smaller scale with some pieces of high-explosive shell (lent to him by Dr. Menzies) placed in gelatine, and their vibrations when brought within the influence of the magnet were projected on the screen.

The lecturer concluded with a tribute to what he called the shadow-army (consisting of workers in all branches of war surgery), who followed the movements of the combatant army as exactly as in the experiments he had shown them the shadows on the screen followed every alteration in the position of the lamp.

[1] Abstract of a discourse delivered at the Royal Institution on May 5, by Sir James Mackenzie Davidson.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—On Tuesday, May 30, at a crowded special Degree Congregation, the degree of LL.D. was conferred by the Vice-Chancellor (Mr. Gilbert Barling) upon the Right Hon. W. M. Hughes, Premier of the Commonwealth of Australia. It was felt to be fitting that the University, which owes its foundation so largely to the great Colonial Secretary, should thus honour the distinguished representative of the Overseas Dominion which has taken the lead in the promotion of co-operation between science and industry in the Empire.

LONDON.—At a meeting of the Senate held on May 24 the following doctorates in science were conferred:—D.Sc. in geology, Mr. P. G. H. Boswell, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "The Stratigraphy and Petrology of the Lower Eocene Beds of East Anglia"; D.Sc. in psychology, Miss M. J. Reaney, an internal student of King's College, for a thesis entitled "The Psychology of the Organised Group Game."

OXFORD.—The Waynflete professor of chemistry (Prof. W. H. Perkin) gives notice that the new chemical laboratories in South Parks Road will be open for inspection by members of the University and their friends on Wednesday, June 7, from 4 to 6 p.m.

BY the will of the late Mr. J. Forte, his plantation "Bennetts," and the residue of his estate in Barbados, are left to Codrington College in that island. The value of the bequest is expected to be not less than 10,000*l*.

A PARTY of professors from French universities is visiting this country at the invitation of the British Government. Oxford was visited last week, and on Monday, May 29, the party was received at the University of London by Sir Alfred Pearce Gould, Vice-Chancellor of the University, and members of the Senate. On Tuesday, Mr. Henderson, President of the Board of Education, received the visitors at the offices of the Board, and welcomed them on behalf of the Government. During the day visits were paid to University College, Gower Street, and the East London College. King's College, London, was visited on Wednesday. Cambridge will be visited to-day, and the party will remain there until next Monday, after which visits will be paid to Manchester, Liverpool, Sheffield, Leeds, Glasgow, and Edinburgh. It is proposed to return to France on June 12.

THE relations between science and industry, on one hand, and science and the State, on the other, are being discussed in France as well as in the United Kingdom. In a paper by Prof. H. Le Chatelier, on science in its relations with economic development, in the *Comptes rendus* for May 1, we find ourselves held up as a model in some respects in these matters. Prof. Le Chatelier agrees that in France the general public ("*le grand public, c'est-à-dire le public incompétent*") believes in science, but he says that this is unfortunately not the case either with the public authorities or with the leaders of industry. In Germany any captain of industry is proud of the title of doctor of science; in France this would be ridiculed. In England such men esteem it an honour to preside over meetings of learned societies; in the United States leading manufacturers show their respect for science by gifts amounting already to many millions of pounds. France, also, has not established any institution corresponding to the Physikalisch-Technische Reichanstalt in Germany, the National Physical Laboratory in England, or the Bureau of Standards in the United States, though it has the Institut Pasteur. The too frequent absence of laboratories in connection with works is deplored. It is admitted that the faults are not altogether on the side of the manufacturers, as the source of scientific study is frequently not directed to a practical end, and might be described as intellectual gymnastics. This is a fault of the scheme of education, and it is pointed out by Prof. Le Chatelier that the Academy of Sciences has never been consulted on the question of the organisation of teaching.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, May 23.—Dr. J. M. Purser in the chair.—Prof. W. **Brown**: Note on laminated magnets. When a compound magnet is built up of laminations the distance between the poles decreases as the cross-section grows from an oblong to a square, and when the section further increases from a square to an oblong the said distance then increases. The above result was found to hold whether the steel laminations were placed in contact or separated by slips of paper, but the minimum distance between the poles was, in the latter case, greater than in the former.

PARIS.

Academy of Sciences, May 15.—M. Camille Jordan in the chair.—G. **Lemoine**: The catalysis of hydrogen peroxide in heterogeneous media. Part iv. Experiments with carbon; conclusions. The three varieties of carbon used in these experiments—coconut charcoal, wood charcoal, and sugar charcoal—all acted as catalysers towards hydrogen peroxide, the first being the most energetic. There would appear to be a relation between the catalytic power and absorptive capacity for gases. The results given in the four papers are summarised.—H. **Le Chatelier** and F. **Bogitch**: The estimation of carbon by the Eggertz method. The effects of heat treatment of the steel, of nickel, manganese, and silicon have been examined.—P. **Duhem**: The electrical oscillations on a system of purely dielectric bodies.—C. **Guichard**: The C congruences of which one of the focal surfaces is a quadric.—M. Bergonié was elected a correspondant for the section of medicine and surgery in the place of the late M. Mosso.—J. K. de **Fériet**: An integral equation of the second species, admitting hyperspherical functions as fundamental solutions.—D. **Eginitis**: Observations of the comets 1915*a* (Mellish) and 1915*e* (Taylor) made at the Athens Observatory with the Doridis equatorial.—P. **Villey**: A stenographic machine for the blind.—A. **Colson**: The consequences of the assimilation of reversible solutions to saturated vapours.—C. **Raveau**: The complete expression of the heat of reversible solution in a volatile liquid.—L. C. **Maillard**: The formation of pyridine bases, starting with albuminoids. Remarks on a recent communication on the same subject by MM. A. Pictet and Tsan Quo Chou.—Mlle. R. **Hemmerlé**: Diphenylpyruvic acid.—J. **Bougault**: Phenyloxymaleic anhydride. This anhydride is obtained by the action of sulphuric acid upon α-cyanophenylpyruvic ester. It crystallises with one molecule of water, and hence possesses the same composition as phenyloxalacetic acid, but its reactions with alcohols and amines clearly distinguish it from the latter.—MM. J. and C. **Cotte**: The examination of a prehistoric paste. A chemical and microscopical examination of a coloured paste found on two fragments of bone in the eneolithic layers of the cavern of Adaouste.

—P. **Gaubert**: Circular polarisation produced by spherolites.—A. **Guébhard**: The age of the upper conglomerates of the region of Castellane (Basses-Alpes) in its relations with the alpine foldings.—Mlle. S. **Coëmme**: A new method of reproduction of the partitions of Ammonites.

BOOKS RECEIVED.

Bulletin of the Museum of Comparative Zoology at Harvard College. Vol. lx., No. 6. Results of the Yale Peruvian Expedition of 1911. The Arachnida. By R. V. Chamberlin. (Cambridge, Mass.)

Preliminary Report on the Botanical Results of the Danish Expedition to Siam (1899–1900). Flora of Koh Chang. By Johs. Schmidt. Part x. (Copenhagen: Bianco Luno.)

Annals of the Durban Museum. Vol. i., part 3. (Durban.) 5*s*. net.

Journal of the Royal Statistical Society. Vol. lxxix., part 2, March. (London.) 5*s*.

Transactions of the Royal Society of South Africa. Vol. v., part 4. Pp. 273–564. (Cape Town.) 12*s*. 6*d*.

Mentally Deficient Children: their Treatment and Training. By Drs. G. E. Shuttleworth and W. A. Potts. Fourth edition. Pp. xix+284. (London: H. K. Lewis and Co., Ltd.) 7*s*. 6*d*. net.

More Minor Horrors. By Dr. A. E. Shipley. Pp. xiv+163. (London: Smith, Elder and Co.) 1*s*. 6*d*. net.

Newsholme's School Hygiene: the Laws of Health in relation to School Life. By Dr. J. Kerr. Pp. 352. New edition. (London: G. Allen and Unwin, Ltd.) 4*s*. 6*d*. net.

The Forty-fourth Annual Report of the Board of Directors of the Zoological Society of Philadelphia. Pp. 53. (Philadelphia, Pa.)

A Generation of Religious Progress. Edited by G. Spiller. Pp. 151. (London: Watts and Co.) 1*s*. net.

A Senior Experimental Chemistry. By Dr. A. E. Dunstan and Dr. F. B. Thole. Pp. xiii+522. (London: Methuen and Co., Ltd.) 5*s*.

The Geology of the Lake District and the Scenery as Influenced by Geological Structure. By Dr. J. E. Marr. Pp. xii+220. (Cambridge: At the University Press.) 12*s*. net.

DIARY OF SOCIETIES.

THURSDAY, June 1.

Royal Society, at 4.30.—The Transmission of Electric Waves around the Earth's Surface: Prof. H. M. Macdonald.—A Critical Study of Spectral Series. IV. The Structure of Spark Spectra: Prof. W. M. Hicks.—Periodic Disturbance of Level arising from the Load of Neighbouring Oceanic Tides: K. Terazawa.—The Use of Partly Neutralised Mixtures of Acids as Hydrion Regulators: E. B. R. Prideaux.—The Fossil Floras of the Coal Measures of South Staffordshire: Dr. E. A. N. Arber.

Royal Institution, at 3.—Chamber Music and its Revival in England: Sir Alexander Mackenzie.

Royal Society of Arts, at 4.30.—The Work of the Imperial Institute for India: Prof. W. R. Dunstan.

Linnean Society, at 5.—New Types of Fossil Characeæ from the Purbeck Beds: Clement Reid and J. Groves.—The Structure of the Vertebral Column in the Anura Phaneroglossa and its Importance as a Basis of Classification: Prof. G. E. Nicholls.—Variation in Mnium: Prof. Julius MacLeod.—A New Species of Bennettites: Dr. Marie Stopes.

FRIDAY, June 2.

Royal Institution, at 5.30.—La France dans l'Histoire comme Champion du Droit: Lieut. P. H. Loyson.

Geologists' Association, at 7.—The Petrology of the North Sea Drift and Suffolk Brick-earths: Dr. P. G. H. Boswell.—Notes on Erosion Phenomena in Egypt: Mary S. Johnston.

SATURDAY, June 3.

Royal Institution, at 3.—Folk-lore in the Old Testament: Sir J. G. Frazer.

MONDAY, June 5.

Royal Geographical Society, at 8.30.—Further Explorations in Central Asia: Sir Aurel Stein.

Aristotelian Society, at 8.—The Nature of Judgment: E. H. Strange.

Society of Chemical Industry, at 8.

Victoria Institute, at 4.30.—The Tides, with Special Reference to their Effects around the British Isles: Prof. E. Hull.

TUESDAY, June 6.

Royal Institution, at 3.—Optical Research and Chemical Progress: Dr. T. M. Lowry.

Zoological Society, at 5.30.—*Discussion*: The Results Published in the "Biologia-Centrali-Americana," with Special Reference to the Zoogeographical Relations between America and Africa—Opened by Dr. F. Du Cane Godman, followed by Dr. A. Smith Woodward, Dr. H. Gadow, C. Tate Regan, R. I. Pocock, and Dr. C. W. Andrews.

Röntgen Society, at 8.15.—Annual Meeting.—Homogeneity of Visible Radiation: Prof. J. W. Nicholson.

WEDNESDAY, June 7.

Society of Public Analysts, at 8.—Determination of the Reichert and Polenske Figures of Butter and Margarine, using Small Quantities of the Fat: A. Douglas Heywood.—Potash and other Mineral Fertilisers and Constituents of Plants: R. R. Tatlock and R. T. Thomson.—Estimation of Acetone in the Presence of Ethyl Alcohol: Jitendranath Rakshit.

Geological Society, at 5.30.

Entomological Society, at 8.—Certain Forms of Acraea from Madagascar: A Reply to M. Oberthür: Dr. H. Eltringham.

THURSDAY, June 8.

Royal Society, at 4.30.

Royal Institution, at 3.—Chamber Music and its Revival in England: Sir Alexander Mackenzie.

Institution of Mining Engineers, at 10.45 a.m.—The History of the Safety-Lamp: Prof F. W. Hardwick.—The Health of Old Colliers: Dr. J. S. Haldane.—The Estimation of Moisture in Coal: T. F. Winmill.—(1) The Absorption of Oxygen by Coal. VIII. and IX.; (2) The Oxidation of Pyrites: T. F. Winmill.

Optical Society, at 8.—Modern Technical Applications of Radium and other Luminous Substances: F. Harrison Glew.

FRIDAY, June 9.

Royal Institution, at 5.30.—Eyesight and the War: Dr. E. Clarke.

Royal Astronomical Society, at 5.

Malacological Society, at 8.—Note on *Erato guttula*, Sow.: J. R. le B. Tomlin.—An Undescribed Ammonoid from the Lower Greensand (Aptian) of Kent: G. C. Crick.—*Helix scytodes*: Prof. G. K. Gude.

SATURDAY, June 10.

Royal Institution, at 3.—Folk-lore in the Old Testament: Sir J. G. Frazer.

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THURSDAY, JUNE 8, 1916.

THE MOVING PICTURE AND ITS MECHANISM.

Hopwood's Living Pictures: Their History, Photo-Production, and Practical Working. By R. B. Foster. New edition, revised and enlarged. Pp. x+377. (London: The Hatton Press, Ltd., 1915.) Price 6*s.* net.

THE last twenty years have seen such amazing development, both technically and industrially, in all that pertains to moving-picture devices that it is difficult to realise how long ago observations were made and simple devices constructed which by slow degrees led to the position from which the present activity has sprung. The whole story is well told in the new edition of Hopwood's "Living Pictures." The reviser has the advantage not only of a good scientific education, but also of that special training required for members of the legal profession, and this is reflected throughout the book in the strictly accurate statements of the problems at every stage and lucid descriptions of the method of solution. Further, the classification of the numerous modes adopted by different inventors for arriving at the desired end is a help to the reader and avoids the confusion which a merely chronological treatment, for instance, would introduce. Two other features should be mentioned. The early history, beginning with the observation of Dr. Roget on the appearance of the spokes of a wheel seen through a fence, is interesting, in that we find how many of the best-known scientific workers made contributions to the general subject. The following is a list of some of these: Brewster, Wollaston, Babbage, Herschel, Plateau, Faraday, Savart, Wheatstone, Clerk Maxwell, Marey, Janssen.

The second feature for which we have to thank the reviser is the excellent account of the legal side of the question, not only with regard to the restrictions where public exhibitions are concerned, but also in respect of the patents bearing on the subject, of which there is a complete classified list. Unfortunately, owing to considerations of space, this only contains the date and number, but not the name of the patentee or the title. In addition there is a valuable exposition of the state of the law in relation to copyright. It appears to the writer that the inventor will find this book of great use, owing largely to the careful way in which the problems are dissected and classified under sub-subjects, so that whatever ideas he may have he will be able to compare with existing practice or proposals by reference to only a few pages.

The subject is so vast that it is impossible in a notice to discuss more than one or two parts of it. The author has, in the historical section, preserved an astonishing number of inventors' names for their instruments, derived mostly from the Greek. The greater number of these are now wholly forgotten, though Thaumatrope, Zoëtrope, and several others are still remembered. Later inventors, with their kinematographs vulgarised to sinnema and other -graphs and -scopes, have, however, not entirely succeeded in imposing this class of language upon the profession, who have adopted the short and simple expression "movies" as a general term for moving pictures.

In the earlier discussions it is natural that the question of persistence of vision should have claimed much attention. The accepted views have been revised from time to time when new demands were made upon this physiological limitation, as, for example, when three-colour moving pictures or stereoscopic moving pictures, in which the two eyes alternately see succeeding views, were first discussed. It is a question whether persistence of vision is an accurate expression in relation to moving pictures at all. It is exact where the eye blends a number of successive views of a stationary object, but where the successive views are obtained of a moving object persistence is exactly what is not present. That which the brain creates for the eye is a supposed seeing of the object in all the intermediate positions which it never really sees at all, giving the idea of equable movement. Those who are familiar with the old slipping magic-lantern slides, or remember the old Zoëtrope slides, will realise how much the brain or the imagination can do in this respect. The modern moving picture does not call for a fraction of this creative faculty, except that projected pictures, as distinct from illuminated pictures, seem to make much greater demands upon it. It is probable that the reason for this is that the really successful Zoëtrope slides were those in which the prominent feature was a large object moving slowly, and, perhaps, turning also, while those with many small moving parts were not a success. The modern moving picture must of necessity meet all cases as they arise, but, even so, there remains obvious the greater perfection of the view presented by large objects moving slowly, as, for instance, wave motion on water, as compared with smaller objects in quicker movement, such as the arms and legs of living creatures, while the spokes of a moving wheel which succeed one another about as often as the individual pictures in the series do remain hopelessly unmanageable.

Chap. iv., on "Film Machines and Intermittence Mechanisms," is one of special interest, and it well illustrates the excellence of the classification, for every known method of arresting the film for the necessary time, or of making it appear stationary by optical means, even though it is in reality moving continuously, is set out under a suitable heading, and the mechanical difficulties and limitations of the different methods are well explained. In the writer's opinion, the discussion of the Maltese Cross movement, a movement of the type of the Geneva stop mechanism of clocks and watches, is treated in an unnecessarily cumbrous manner. This is due to the use of trigonometrical expressions, which are not well adapted for the treatment of this class of movement. Some seven pages might be replaced by

one or two, in which the problem could be discussed with abundant accuracy simply by the use of the geometric principle enunciated in text-books in dealing with the forms of the teeth of wheels.

The development of the moving picture and its mechanism, like that of many other inventions, has had to wait for, and has stimulated invention in relation to, its own elements or adjuncts. For instance, the early workers in moving-picture photography were met first by the insufficient sensitiveness of the photographic plate. The wet plate, with its silver bath, was, of course, hopeless; but the dry plate, with all its advantages of easy manipulation, has steadily improved in its requirements of light to make a good picture, until this has ceased to be a serious difficulty in a good light. However, the glass plate itself limited the number of pictures in a sequence to those that could be arranged in a spiral on a disc, and so was wholly inconsistent with the modern moving picture exhibition. The film, and with it the series of devices for sensitising, developing, fixing, washing, and perforating, had to be created before the moving picture as now understood could exist.

Two other questions discussed are those of colour kinematography, and living and speaking pictures. The explanation of the two methods of obtaining the three-colour components, the one by addition and the other by subtraction, is exceedingly clear, and this makes the discussion of the methods of different inventors the more luminous. Some stress is laid, and rightly so, on the Urban-Smith two-colour method, patented in 1902, which is the basis of the popular kinemacolour. The author does not state that this patent was the subject of an action which was hotly contested as far as the House of Lords, when a judgment was delivered which is of the most drastic kind in relation to ambiguity and confusion of language in a specification. This judgment is now constantly quoted, and is one which was much needed in consequence of the improper use of English patent protection, made more especially by American and German patentees. While there was no dishonest intention of this kind exhibited in the specification in question, there is no doubt that our Patent Office has been induced to allow patent specifications to be issued which are designed to mean anything in emergency, to the great advantage of the big bully; and, thanks to a kinemacolour specification, we now have in a judgment a cure so drastic as possibly to be more dangerous to the honest inventor than the disease.

In the speaking picture not only is the moving picture projected, possibly in colour, but the sounds heard at the time at which it was taken are reproduced also. When it is remembered how quick the eye and ear are to perceive want of synchronism, it will be realised what the mechanical difficulties are that must be surmounted in producing a successful speaking picture. Those who had the good fortune to be present at the Royal Institution when the Gaumont speaking pictures were exhibited in 1913 will remember how perfectly every element separately, and the whole conjointly, were produced. Of the colour effects the most astonishing were those of butterflies, with those brilliant iridescent blues and purples which would seem to defy imitation. However, after the photograph of those butterflies mounted on clockwork stands so as to revolve slowly had been shown, the originals on their stands were set revolving on the table, and it was seen that as far as the memory would serve the succession of iridescent hues, caused by the changing aspect of the wings, was identical in the original and in its presentation on the screen, and it appeared that Clerk Maxwell's three-colour theory of colour vision could not have a better proof of its sufficiency. However, the butterflies did not speak. Other pictures, one of a cock crowing, another of lions in a cage being annoyed by a bar of iron which was allowed to drop on to the stone floor, were each achievements of so perfect an order that, so far as the experience of the present writer goes, no moving picture had been so equable and free from flicker; no colour picture, whether moving or not, projected on the screen had approached these in faithful accuracy of colour; no gramophone—except, perhaps, the Autexophone of Parsons—had given so faithful a sound record; and the combination of the whole and the exact synchronism were such not only that the motion of the cock agreed with his voice, but the clink and ring of the iron exactly agreed with the moment at which it was seen to strike and bounce from the floor, while the lions were keeping up a snarl in consonance with their features. Where so much was attempted a failure in any part, and above all in the synchronism, would have converted the feeling of amazement and delight experienced by the audience into one of disgust at the obvious sham of the whole thing.

In addition to the list of patents to which reference has already been made, there is a bibliography covering the period from 1825 (Roget) to 1914 (Hallberg), and a list of British and foreign periodicals devoted to the subject.

C. V. BOYS.

MODERN ANALYSIS.

A Course of Modern Analysis. By Prof. E. T. Whittaker and Prof. G. N. Watson. Second edition, completely revised. Pp. 560. (Cambridge: At the University Press, 1915.) Price 18*s.* net.

THE treatise now under notice, which appears as a second edition of a former treatise by one of the authors, is in all essential respects a new work. Its scope has been extended in many directions, and very recent developments, of which a substantial number are due to the authors, receive a fair share of attention. The volume now gives a somewhat exhaustive account of the various ramifications of the subject, which are set out in an attractive manner. An unusually complete set of references is included, and the book should become indispensable, not only as a textbook for advanced students, but as a work of reference to those whose aim is to extend our knowledge of analysis. The references to original

memoirs are conveniently arranged at the ends of the chapters.

Part i. is concerned with the processes of analysis. After an introduction to complex numbers, continuous functions, and the more fundamental theory of convergence and uniformity, the reader passes to the theory of Riemann integration. Analytic functions are then introduced, and an account of Cauchy's theory of residues is followed by the theory of the development of functions in various forms of infinite series. The chapter on asymptotic expansions and summable series is very compact, and in the ensuing chapter, on Fourier series, the authors have taken the bold course of treating these series by the elegant means of Cesàro's theory of summable series, instead of by Dirichlet's method. But as the theory of these series only appeals to the pure mathematician, who finds Dirichlet's method equally difficult, this course appears to be justified. Part i. concludes with a valuable chapter on integral equations, which, like those on the theory of integration and linear differential equations, is new.

Part ii. is devoted to the theory of the special transcendental functions, and commences with a very complete account of the Gamma function. The statement that this function was defined by Euler as an integral is slightly misleading; he obtained a limit of a product by interpolation from factorials, proved it equal to a Beta integral, and thence derived the Gamma integral. Possibly, however, the writers do not regard the product as being suitable for a definition, for it is not of Weierstrass's canonical form, and, indeed, it is difficult to show that it represents an analytic function. A sketch of the theory of the Zeta function of Riemann, from the point of view of analytic functions, is given, although an account of its applications to prime numbers seems to have been considered beyond the scope of the book. The work of Mellin and Barnes, which has appeared since the first edition, has enabled the authors to give a more brief and systematic account of the hypergeometric function and of its "confluent" form. As particular cases of these functions, the harmonics of the parabolic cylinder, and, of course, the Bessel functions, are considered in some detail. A chapter is devoted to the differential equations of mathematical physics, and a pleasing novelty is introduced into their treatment. The authors are successful in reducing to a minimum the labour inherent in a discussion of Mathieu's elliptic cylinder functions. The book concludes with three long and interesting chapters on elliptic functions, and it is pleasant to observe that Jacobi's notation for the Theta functions has been retained on account of its historical interest. Moreover, it is actually the most convenient of those in existence.

In matters of general arrangement the book is excellent throughout. Peano's system of paragraphing is adopted, and the reviewer can only express the hope that the system may become more universal. An appendix gives the essentials of the more elementary theory of simpler functions, and the index is noticeably complete. The examples are numerous and well selected from the point of view of the student who wishes to pursue the subject. But perhaps the most characteristic feature of the book is its success in giving rigorous proofs of theorems without relapsing into the dullness too often associated with rigour. In every respect it is worthy of the traditions of the Cambridge University Press.

DOCILITY AND OTHER DISEASES.

(1) *The Nemesis of Docility: A Study of German Character.* By E. Holmes. Pp. vii+264. (London: Constable and Co., Ltd., 1916.) Price 4*s.* 6*d.* net.

(2) *La Guerre et la Pensée Médicale.* By Prof. Ricardo Jorge. Pp. 63. (Lisbon, 1916.)

(1) BY docility the author means "readiness to obey for the sake of obeying, avidity for commands and instructions, reluctance to accept responsibility or exercise initiative, inability to react against the pressure of autocratic authority"; and this is what is wrong with Germany, where a slavishly docile majority is as wax in the hands of a dogmatic and domineering minority. The Germans lost their early domestic freedom in becoming feudalised, and they failed to recover it because of the disruptive influences of tribalism. The ultra-docility has grown and is obvious today alike in the Army, with its "serf-like rank-and-file" and its "arrogant, overbearing caste of officers," and in "an almost serf-like people," which bows to the despotism of the Kaiser, the Junker, and the lords of commerce and finance "as to the gracious rule of a divinely instituted 'State.'"

Having been Prussianised themselves, the Germans have sought solace in the dream of "forcibly Prussianising a greater Germany which would expand at last into a world-wide empire." They have also sought to make their dream come true. "The aggressive egoism of an over-docile people is the torch which has set the world ablaze." The blaze has given the world a glimpse of the pernicious way in which over-docility may deaden and brutalise a people. We wish it had left them less effective! That it will eventually betray Germany in the field is evidently the author's expectation, which we cannot but share. We wish again, however, that the symptoms of material Nemesis were a little more convincing than they are as yet, for the temporary success of the thoroughness of the ultra-docility which Mr. Holmes so vigorously damns remains as the active cause of incalculable wastage and misery, and as a terribly disquieting menace to civilisation.

While we are inclined to regard the author's survey as one-sided, and his interpretation in terms of the "ultra-docility" formula overstrained, we feel that he has powerfully presented part of the truth, and driven home the salutary moral: *Fas est et ab hoste doceri.*

(2) This is a beautifully printed lecture on "The War and Medical Thought," delivered in December, 1914, as a presidential address to the

Lisbon Society of Medical Sciences by Prof. Ricardo Jorge. By the wish of the society it has been published in French as well as in Portuguese, and we appreciate this convenience.

The first part of the address traverses familiar ground in contrasting the present-day army medical service with that of former times, emphasising such modern features as prophylactic inoculation and conservative surgery. A deeper note is struck in the author's admission that war in itself—as a biological phenomenon—is directly antithetic to the ideal of medicine, which is the increase of wholesomeness of life. Refusing to be led astray by any apology based on the pervasiveness of the struggle for existence in Nature, Prof. Jorge asks eloquently and passionately how it has come about that the nations have been led into the disastrous anachronism which the war implies. The answer he feels compelled to give is that the controllers of German policy are the victims of a "collective paranoia engendered and sustained by a mental and sentimental intoxication of progressive acuteness—panteutomania." He does not maintain that other countries have not, from time to time, exhibited analogous aberrations, but his contention is that we are confronted with the most terrible "psychodemic" in history. It has invaded even the temple of science, as is shown by the names of many of the 93 signatories to the famous "Appeal to Civilised Nations."

Admitting a profound admiration for the achievements of German science, and for Virchow in particular (from whom some noble-minded sayings are quoted), the author holds to the thesis that there has been in Germany a terrible outbreak of social pathology, a "pandemia vesanica." In spite of these learned terms, which are rather question-begging, and references to Le Bon and other students of the psychology of the crowd, we suspect that Prof. Jorge's theory is largely verbal and metaphorical. The address seems to have been first published in *Medicina Contemporanea,* and a lurid German review by Prof. C. Mense is answered in a manner suggestive of high explosives.

OUR BOOKSHELF.

Spiritualism: A Historical and Critical Sketch. By Rev. Canon Edmund McClure. Pp. viii + 56. (London: Society for Promoting Christian Knowledge, 1916.) Price 6*d.* net.

This is an enlarged version of an address to a small clerical society, one member of which had been caused "distinct anxiety" by the growth of spiritualism. Canon McClure touches on the *Odyssey,* Saul and the Witch of Endor, St. Augustine and St. Thomas Aquinas on demons, Porphyry, Swedenborg (whose "so-called" visions were due to a disappointment in love, acting on a nervous system of "unbalanced character"), Dr. A. Russel Wallace (who is treated with respect and extreme brevity), Mrs. Piper (untruly said to be afflicted with hysteria, like "all mediums"), and Dr. T. J. Hudson, whose insufficiently supported theories are too lightly accepted. The Society for Psychical Research, though often referred to, is not once correctly named, nor is the Dialectical Society; the names Schiaparelli and Blavatsky are wrongly spelt, and an American "Colonel Sinnett" is mentioned who seems to be a blend of Mr. A. P. Sinnett and Colonel Olcott. These and other mistakes will lead scientific readers to distrust the author, who, moreover, has apparently no first-hand knowledge of the subject. The Archdeacon of Bristol, in his preface, seriously recommends those who desire further knowledge to read Monsignor Benson's novel "The Necromancers"! Both writers have apparently decided that the alleged phenomena are due to fraud, hysteria, or the Devil.

Canon McClure says (p. 50) that hysteria plays an important part in the functions of all mediums, "and notably, according to Prof. Richet, in Mrs. Piper." The present reviewer, through the kind offices of a friend, communicated this statement to Prof. Richet, whose reply is just received, after the foregoing was in type. He emphatically denies ever having said anything of the kind. J. A. H.

Manuring for Higher Crop Production. By Dr. E. J. Russell. Pp. vii + 69. (Cambridge: At the University Press, 1916.) Price 3*s.* net.

The problem of increasing the food output of British farms is no new one, but has been rendered vastly more acute by the stern necessities of war-time. The solution of the problem lies obviously along one or both of two lines: either the farmer must increase his area under cultivation, or he must obtain more from the existing area. To the layman the former alternative may appear to promise the larger results, but its practical application in war-time is beset with grave difficulties, which tend only to increase with the prolongation of the war. The efforts of the farmer must thus be concentrated more and more in the direction of the second alternative, endeavouring by improved cultivation, readjusted crossing, and more liberal and rational feeding of his crops to utilise to the fullest extent the capabilities of his soil.

It is to assist him in the pursuance of this object that Dr. Russell has epitomised in this small volume the essential information now available on manures and soil management, with special reference to British experience, and the results of numerous field trials made at Rothamsted and elsewhere in this country. His aim throughout is to state the facts in simple and plain language, with sufficient illustrative data from experimental results to enable the individual farmer to draw his own conclusions as to the probable requirements of his own soil. There are no simple formulæ for increasing crop production. Local conditions must exercise a dominating influence. The skill and judgment of the farmer in appraising these and in adapting his practice to them must be decisive, but with intelligent application of the facts set out so clearly by Dr. Russell he will be but an incompetent farmer who fails to achieve some measure of success in increased crop and enhanced returns.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Molecular Attractions in Solutions.

THE following is, so far as I know, a new method of attacking this problem. I have been working at the experiments for some time, but on account of the war progress in the matter has come almost to a standstill. It seems desirable to publish this brief preliminary note now.

Let A and B be two pure liquids miscible (completely miscible would be better still) over a large range of concentrations. Let the densities and compressibilities of the liquids and their mixtures be known. Then, taking the simplest case (*i.e.* one in which there is no association either in the mixture or in the pure liquids), we may postulate that if there be a change in volume on mixing, this change is caused by the algebraic sum of the alterations in the attractions of A to A and B to B, together with the added effect of the new attractions of A to B.

The sum of these three effects can be calculated with considerable plausibility. Consider any definite mixture, the coefficient of compressibility of this mixture being supposed known over a wide range of pressure. As we know the coefficient for the separate pure liquids, we could calculate the theoretical coefficient of the combination. From these data we can get an approximate value for the mean coefficient of compressibility of the mixture while passing, so to speak, from the theoretical combined state to that which ultimately prevails. Then the change in volume divided by this mean coefficient gives the change of internal pressure on mixing. Now, if this method be followed by a number of different concentrations, a series of different changes in internal pressures will result.

If it is desired to disentangle the various internal attractions from one another, this can only be done by trial and error. The following development of Laplace's method may be tried. Assume that the attractions are proportional to the mass of the operative particles, then, calling the changes of pressure P_1, P_2, etc., and referring the concentrations to a gram-mol. of liquid A, let V be the volume of the mixture which contains 1 gram-mol. of A, and n the accompanying mass of component B.

The change of attraction of A to A in mixture (1) will be proportionate to α/V_1^2.

The change of attraction of B to B in mixture (1) will be proportionate to $\beta n_1^2/V_1^2$.

The change of attraction of A to B in mixture (1) will be proportionate to $n_1\gamma/V_1^2$.

From these quantities we get a set of equations:—

$$P_1=(\alpha+n_1\gamma+\beta n_1^2)/V_1^2,$$
$$P_2=(\alpha+n_2\gamma+\beta n_2^2)/V_2^2, \text{ etc.},$$

where α, β, and γ are algebraic quantities.

There are some reasons for supposing that γ may be equal to $(\alpha\beta)^{\frac{1}{2}}$; if so, α and β can be calculated from any two of the equations, when P_1, n_1, etc., are known, and hence the validity of the assumption may be tested over any range of concentrations. Obviously a formula of this type would not meet the case in which the two liquids can mix in all proportions without change of volume; but it is possible that although the total pressure now remains constant, yet there may have been a redistribution of pressure among the constituents.

It may be mentioned that even an empirical formula giving approximate values for the separate internal pressures would be of considerable help in deducing a correct equation of state for the osmotic pressures of solutions.

BERKELEY.

Foxcombe, May 24.

Meteorological Conditions of a Blizzard.

As used to signify a certain type of snowstorm primarily characterised by fine, dry, powdery, or sand-like snow driven before a gale of wind, the temperature of which is extremely low (say 20° below zero F.), the term "blizzard" is, of course, wholly inapplicable in the British Isles; and it is, moreover, ridiculous to apply the name to every little occurrence of sleet after the manner of the daily Press, referred to by Mr. Dines. But there is another type of severe snowstorm peculiar to damp, stormy, and relatively warm winter climates like our own, the natural breeding-grounds of which are the wild tracts of bleak, elevated moorland which cover so much of the north of England and Scotland; and I fail to see why "blizzard," which, after all, comes from the same root as "blast," should not be as expressive of a British moorland snow gale, with its relatively large damp flakes, as it is of the fine dry crystals of North America or the polar regions, produced by meteorological conditions practically unknown in this country. The huge falls of snow swept by heavy gales which isolated many high-lying districts of Great Britain for weeks together in February and March of the present year (see *Symons's Meteorological Magazine* for April), bringing in a few weeks an aggregate depth of some 10 ft. to the Black Mountains in South Wales, were, it seems to me, not inappropriately described as "blizzards"; but for the sake of distinction it might be advisable to restrict the use of the term to the American type of storm.

Mr. Dines refers to January 18, 1881, as affording the nearest approach to an American blizzard in the S.E. of England; but possibly an even better approximation was the great storm of March 9–13, 1891, in the S.W. of England. In Devon and Cornwall the "great blizzard" of that spring is now a household word, and I do not think that anyone who either experienced that west-country visitation or has read the vivid narratives regarding its effects will feel inclined to quarrel with the designation.

L. C. W. BONACINA.

Hampstead, N.W., June 2.

SIR ERNEST SHACKLETON'S ANTARCTIC EXPEDITION.

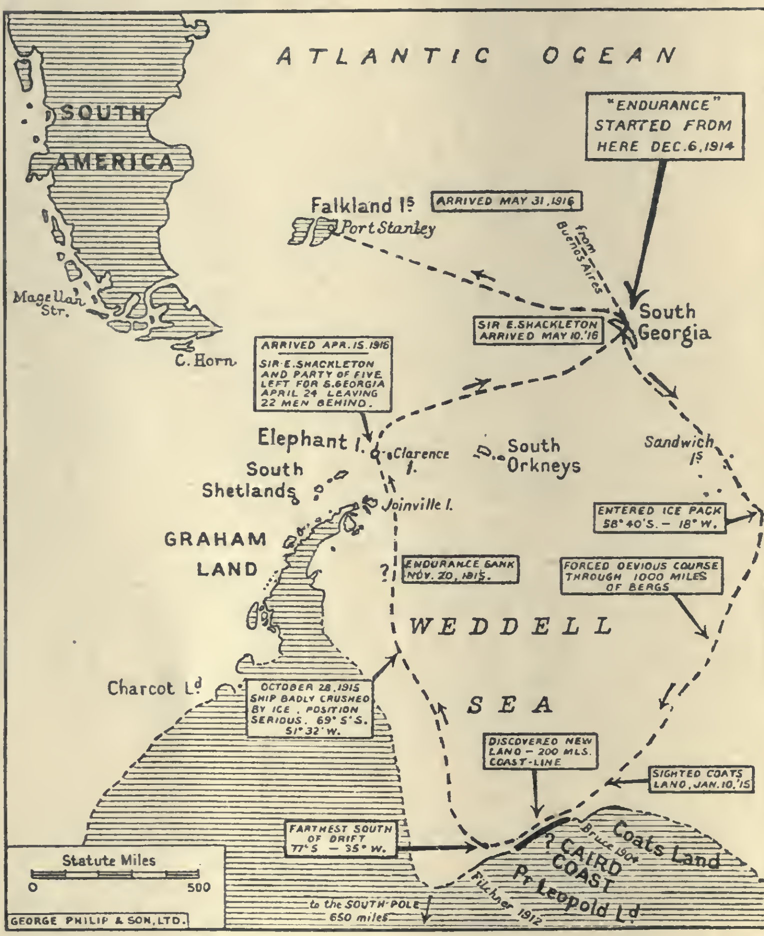
SIR ERNEST SHACKLETON has fully justified the faith of those who were confident that if he did not cross Antarctica his expedition would make valuable additions to the geography of the little-known area of the Weddell Sea and that he would act with the combined daring and sound judgment necessary to success in what was admittedly almost a geographical forlorn hope. He is to be congratulated on his return after one of the most adventurous of Polar expeditions; for its voyage on the ice-floes has been only equalled in perils by that of the Hansa Expedition; his heroic passage in search of help across the stormy seas south-east of Cape Horn during an Antarctic winter will rank among the finest examples of seamanship achieved in an ordinary ship's boat; and, having landed on

the uninhabited side of South Georgia, he has achieved the fine mountaineering feat of the first traverse of that rugged ice-capped island.

The narrative of Sir Ernest Shackleton in the *Daily Chronicle* of June 2 confirms the expectation that the *Endurance* had come to grief in the heavy ice of the Weddell Sea. She left South Georgia on December 6, 1914, and sailed to the south-east, entering the pack at 58° 40′ S., 18° W. After a passage of 1000 miles through crowded ice-floes Coats Land was sighted on January 10, 1915. The expedition, continuing westward, discovered 200 miles of new land, the Caird Coast, which appears to fill the gap between Coats Land and Filchner's Prince Leopold Land, and thus to prove that they are part of the Antarctic continent and not off-lying islands. The *Endurance* was, however, unable to reach the hoped-for base. From the latitude of 77°, her furthest south, she was carried northward, the direction of drift being apparently controlled by land to the west. This land does not, however, extend as far east as was thought. Capt. Benjamin Morrell, an American sealer, claimed to have discovered land, which he called New South Greenland, in 1823. Morrell was generally dismissed as the Munchausen of the Antarctic until Dr. Bruce accepted his records, largely on the ground that his other record of new land was supported by Ross's observation of apparent land at 75° S., 44° W. If those two records had been confirmed, the land to the west of Weddell Sea would project north-westward in two great peninsulas, Grahamland to the north-west, and Morrell's New South Greenland to the south-east. The axes of these lands would have been concentric with one another, and also with the line, further to the north-west, of the South Shetlands and South Orkneys.

Sir Ernest Shackleton has found 1900 fathoms of water over the site of New South Greenland. He has therefore restored to the Weddell Sea its great extension westward and modified the possible interpretation of the structure of the Grahamland region. Morrell may have mistaken ice for land or may have been merely wrong in his longitude—a very excusable mistake at that date; and that an extensive land exists not far west of the course of the *Endurance* is suggested by the exceptionally heavy ice pressures by which she was wrecked; but the supposed peninsula to the south-east of Grahamland and Ross's apparent land are definitely disproved.

The *Endurance* was crushed on October 28, and sank on November 20 as the ice opened during the drift further to the north. The expedition camped on the floes, and passed in sight of Joinville Island, off the north-eastern end of Grahamland, but it was inaccessible. The expedition endeavoured to reach Deception Island, where there are huts and stores of food; but it was unable to force a way to the western end of the South Shetlands and landed, on April 15, on Elephant Island, one of its north-eastern members. It is a rugged, cliff-bound island rising to the height of 3500 feet, and though there are fair anchorages, landing appears to be difficult. As the food supply was low Sir Ernest Shackleton left twenty-two of his men camped in an excavation in the ice and started, on April 24, with Capt. Worsley and three others, in one of the ship's boats for South Georgia. The Falkland Islands are nearer; but South Georgia offered an easier course and the attraction that one of its whalers might be available for the immediate rescue of the party on Elephant Island.



Map of Sir Ernest Shackleton's route. Reproduced by permission of the *Daily Chronicle*.

Shackleton reached the western coast of South Georgia and climbed over the Allardyce Range to the whaling station at Stromness Bay. The fact that the island had not been crossed before gives some indication of the difficulty of this feat, which can also be realised from the map and photographs published in Mr. Ferguson's recent memoir on the island (Transactions Roy. Soc. Edinburgh, vol. l., part iv., 1915). A relief expedition was at once despatched to Elephant Island, but only an eighty-ton vessel was available, and the ice was too thick for her to force a passage to the land.

The Government has already promised the funds for the larger rescue expedition which had appeared necessary. The problem is now much simplified, as the work to be done is definitely known. Elephant Island—in 61° 10′ S., about the latitude of the Shetlands—though sometimes surrounded by drift ice, can apparently be reached by a suitable vessel at any season of the year. Relief is obviously wanted urgently. The party on April 24 had only five weeks' provisions, which it can doubtless supplement by penguins and perhaps seals. The name Elephant Island refers to the once-abundant sea-elephants; but as the island is easily accessible they have been practically exterminated there; and Sir Ernest Shackleton's account of the locality where his comrades are camped suggests that it may be a very difficult hunting-ground.

The larger South Georgia whalers are probably now on their way to Europe, and unless a suitable steamer can be obtained in Argentina or at the Falkland Islands it is to be hoped that the whaler nearest to South Georgia can be promptly intercepted and sent back there, *en route* for Elephant Island.

RETURN CURRENTS AND ELECTROLYTIC CORROSION.[1]

THE two memoirs referred to below are part of the series of valuable contributions which are being issued by that admirable institution, the U.S. Bureau of Standards, under the able directorship of Dr. Stratton.

The publications before us relate to the troubles which arise from the electric return currents that leak through the soil from electric tramways and railways, in consequence of their setting up electrolytic corrosion in buried pipes or other metallic objects in the neighbourhood of the tramway or railway lines. This was an acute question in Great Britain as well as in North America some twenty years ago when electric traction was a novelty. But, so far as England is concerned, it long ago ceased to be acute in consequence of the prompt action of the Board of Trade. That often abused body framed a regulation that the maximum allowable voltage drop between any two points of the earthed return-system, near which underground metallic structures are laid, should be limited to seven volts. This limitation, though not an absolute safeguard against stray currents, has practically solved the difficulty; and we never, or seldom, hear any suggestion of electrolytic corrosion. Were any considerable difference of potential between two points of an earthed return system to be allowed to subsist, that difference of potential would have the result of forcing a fraction of the current to leave the return rails at some point of higher potential and to find its way through the soil or other available path, to re-enter the return rails at some point of lower potential, presumably nearer the generating station or sub-station. If such stray or vagabond currents merely traverse moist soil in widespread paths they do no damage; but if a waterpipe, or other metallic object, lie along their course, some of the current will find a readier path along such conductor; and wherever the current emerges from the metallic conductor into moist surroundings, electrolytic action will ensue, corroding and pitting the metal surface—sometimes with disastrous effects. Various palliatives, such as the better bonding of the return rail tracks, the use of return feeders, the careful connecting of the negative side of the system to the metallic pipes or other objects by metal connectors, have been used, including the employment of appliances called negative boosters.

The first-named of the monographs before us is devoted to a discussion of the electric conductivity of various kinds of soils under various conditions of moisture, pressure, and temperature, and the effects of these factors on the electrolytic corrosion question. Methods of measuring the resistivities of soils *in situ,* as well as in the laboratory, are discussed. The soil of cities appears to be more highly conductive than that of country districts by reason of absorption of drainage and sewage. The presence of refuse in "made" land is distinctly promotive of conductivity, and therefore of electrolytic corrosion. The authors of the monograph, Messrs. McCollum and Logan, have done their work thoroughly, and have added statistical tables, which, in countries like the United States, where legislation has not intervened to stay the damage, must be very valuable.

The second memoir, by Messrs. Rosa and McCollum, is a lengthy discussion, as an engineering problem, of the mitigation of electrolytic corrosion, or as they rather unfortunately describe it, of "electrolysis." They deal with corrosion in reinforced concrete; with attempts to prevent corrosion by protective coatings of paint; with the use of insulating joints in pipes; with electrical means of combating or compensating the tendency to stray currents; with summaries of the various legal regulations in use in different countries. It appears that the Bureau of Standards has issued eight different publications on this subject. The present memoir alone extends to more than 143 pages.

[1] "U.S. Department of Commerce. Technologic Papers of the Bureau of Standards (Washington)." No. 26, Earth Resistance and its Relation to Electrolysis, etc. No. 52, Electrolysis and its Mitigation. (Washington: Government Printing Office, 1915.)

SCIENCE AND GOVERNMENT.

THERE have been many signs lately of awakened interest in the national significance of scientific method and work, and not the least encouraging among them is the action taken by scientific workers, individually and collectively. Until the war compelled attention to be given to all matters affecting national efficiency, both in the present and the future, little heed was paid to the warnings of those who discerned clearly the consequences of the neglect of science by the State. For this indifference men of science must themselves accept a share of the responsibility. With a few notable exceptions, they did nothing to enlighten the community as to the close relation between scientific work and modern progress, or to promote reforms by organised effort. It is not surprising, therefore, that the place of science in national polity is not understood by the general public, and that the activities of even such representative bodies as the Royal Society and the British Association are commonly regarded as of little practical importance.

The neglect of science by the public has, indeed, been due largely to the neglect of the public by science. The only body which has seriously endeavoured to show the bearing of science and scientific method upon public affairs of every kind is the British Science Guild; yet until recently its objects, and the work of its various committees, were disregarded by a large part of the scientific world. It is a satisfaction to know, however, that the pioneers of the movement for a fuller recognition of science by the State have exerted a sub-conscious influence upon the minds of scientific men, as evidenced by the manifestoes lately issued, and the meetings held, upon the subject of the co-ordination of science with industry, education, and administration, which the Guild has been urging for the last ten years. The Royal Society has formed a conjoint committee of members of scientific societies; a Reorganisation Committee has been constituted to deal with science in the public schools, at Oxford and Cambridge, and in examinations for the public services; an Education Reform Council, having upon it representatives of science, industry, and commerce, as well as of education, has been brought into being by the Teachers' Guild; and suggestions for reforms have been issued, or are being deliberated, by all these bodies.

The latest expression of scientific opinion is contained in the memorial, reprinted on p. 305, from the professorial staff of the Imperial College of Science and Technology, to Lord Crewe, the chairman of the governors. The memorial was presented to Lord Crewe by the Right Hon. A. H. D. Acland, chairman of the executive committee of the governors; Sir J. W. Wolfe-Barry, chairman of the delegacy, City and Guilds (Engineering) College; and Sir Alfred Keogh, Rector of the Imperial College; and it was signed by the twenty-one professors whose names appear at the end.

To those who are acquainted with such utterances as are contained in Huxley's essays on "Science and Education," Sir William Huggins's Royal Society addresses on "Science in the State and in the Schools," Prof. Perry's "England's Neglect of Science," and Sir Norman Lockyer's presidential address to the British Association in 1903, contained in his "Education and National Progress," most of the educational points raised in the memorial will be familiar; nevertheless, it is well that they should be impressed again upon the public mind. The war is arousing the nation to a sense of the need for the adoption of new measures to enable it to compete successfully in the struggles before it; and scientific men have now an opportunity of exerting strong influence upon the schemes of reconstruction which are being put forward. Sporadic memorials are worthy enough in intention, but their effect will be ephemeral unless the signatories to them unite to form a strong and active body of opinion which will guide the country aright. The British Science Guild provides the machinery by which this end may be reached; and it is the obvious duty of all who believe in the application of scientific method to national affairs to give their practical support to an organisation which exists solely for that purpose.

Dissatisfaction with existing means of school preparation for the strenuous conditions of modern life is being expressed on all sides, and it is evident that the country would welcome a practical programme in which scientific principles occupied a prominent place. Most progressive people are now convinced that radical reforms are needed in teaching and outlook, and they are looking to representatives of science and other branches of modern learning to state exactly what should be done. In the absence of a constructive scheme in which all advocates of reform will co-operate, the citadels of traditional studies will stand unshaken, and the vested interests in them will remain untouched, be memorials never so numerous. Our educational and scientific deficiencies have been revealed by the war, and the nation is anxious to see them remedied without further delay. A letter published in the *Times* of June 5, and reprinted on p. 306, is a characteristic statement of this feeling, and we believe it will receive wide support from the parents of the public school to whom it is an appeal.

It is unlikely that the Headmasters' Conference, the members of which are practically all classical men, will be moved by this demand for less classics and more science in the public schools, but if they continue to obstruct advance action should be taken by the Government to compel them to stand aside. Not a single sound argument can be put forward for the waste of effort in schools and universities caused by the existence of the traditional curriculum of classical studies, and the sooner it is superseded by courses more in touch with the actual needs of the times, the better will be the prospects of increased national efficiency.

(1) SCIENCE IN NATIONAL EDUCATION.

We, the undersigned, submitted to you in March last a brief memorandum in support of a memorial which had then recently appeared on "The Neglect of Science." We believe that you will welcome a further statement from us as to what, in our opinion, the Government could do in regard to this important subject, and we have, therefore, tried to indicate some of the ways in which, in our opinion, the Government might render a service to the nation on this matter.

We assume it to be accepted that it would be an advantage to the country if more trained men of science could be found in our public services, and that it is desirable that a larger proportion of boys and young men than at present shall have instruction of the best kind in science, as an essential part of their education. It is needless to say that we do not underrate the importance of the teaching of languages and other subjects as part of a good educational curriculum, nor do we believe that an education which includes good teaching of science need be a narrow education.

What seems to be primarily needed is that at this critical time in our history the Government, through some of its leading members, shall speak plainly to the country on the question of national education, and shall guide and instruct the public in a matter where there is still so much lethargy, misconception, and ignorance. There have been many reports by associations and societies, and advisory bodies, and departmental committees, and Royal Commissions. A strong lead from the Government itself, or a Ministerial Committee announcing a policy and offering guidance, would now be of the highest value. We do not pretend to indicate what that policy or that guidance should be, but we wish to mention some matters which appear to demand early attention.

A large body of opinion at Oxford and Cambridge, and in the country generally, is in favour of altering the conditions of entrance to these universities. It has been clear for a long time that to effect reform in this and other matters an alteration in the method of their government is required. And yet generation follows generation and nothing is done. Is it not desirable that, at any rate immediately after the war, the legislative changes which are desirable shall be introduced into Parliament by the Government? The influence of the old universities through their endowments and their examinations upon the schools is very far-reaching. For this reason the question is of real importance. No reasonable person can think that the study of languages, including the ancient languages, by those who are most able to profit by them will really suffer by reform in this direction.

As regards those public schools where classical education occupies an important or preponderating position, information is needed as to the extent to which school scholarships on entrance to the schools and later are given for successes in which knowledge of Latin and Greek plays a predominating part. It would appear desirable that the boys with brains should be attracted to the modern as much as to the classical side of the schools, as far as the use of the endowments is concerned. At the present time, however, it is the fact that many of the best boys at the public schools are practically forced to the classical side, and it is often only in exceptional cases, as where a far-seeing parent has intervened, that a clever boy has been allowed seriously to study science. If the Government has not full power to obtain the necessary information on the above-mentioned and other relevant matters, it seems desirable that the requisite power should be obtained.

In the past a considerable proportion of the cleverest boys in these schools, and in the preparatory schools which lead to them, have been taught classics from an early age, and because many boys with brains who succeed in after life have been educated in this way, it has been assumed that a classical education is more likely to make a man successful in the public service and in other branches of life than is a modern or scientific education. We believe this assumption to be quite unfounded. The important matter is to allot to boys an education according to their capacity. There is no doubt at all that an enormous amount of time is at present wasted in trying to teach certain types of boys Greek. The effort in these cases is not only of very little value, but, in our opinion, is positively detrimental. In any event a knowledge of Greek literature or culture is notoriously not obtained by merely acquiring an enforced smattering of the Greek language, and the time thus wasted might well be turned to better purpose. Many boys, to whom Greek, and often Latin, too, are completely distasteful, might find in the more practical training of the laboratory and the workshop (which should be coupled with thorough instruction in English subjects, mathematics, and a modern language) an outlet for faculties which an education of a predominantly literary character will never effectively develop.

There is no doubt that at some of the public schools careful attention is given to the provision of teaching of science. The difficulty that often arises is that, in a school where classical teaching predominates, conflicting claims, which cannot be met, are made by parents or by outside examinations on what is called the modern side, and confusion of aim results. The excellent training of our officers in the Navy at Osborne and Dartmouth offers an example of concentration of aim which is worthy of careful attention.

If a Government Committee could report exactly how matters stand in these respects at our public schools, even without any power whatever to make a change, we believe it would have a considerable effect on public opinion.

We viewed with great satisfaction the appointment last summer of a Special Committee of the Privy Council (of which you are chairman) to aid Industrial Research with the help of an Advisory Council, and of other committees which contain men of eminence in science and industry. We hope that the grant of money in Parliament for this purpose will not be stinted, and that the sum of 40,000*l.* allotted for this year will be considerably increased, for our own experience in connection with both science and technology shows how much has yet to be done by the nation in this direction.

We desire to lay very great stress upon the importance of immediately devising means for sending a larger supply of able young men who have been thoroughly educated in science as part of a well-considered curriculum to our universities and colleges. This would provide among men of business, or men in public careers, a larger proportion of individuals trained in scientific methods, which is generally recognised as of great importance. In our own experience, now that many leaders of industry are realising the value of science, we have found, when asked by them to supply the young and promising men that they require, that it has been sometimes impossible to answer their call simply because of a shortage of properly trained men.

There are a large number of boys and young men of real ability to be found in our State-aided secondary schools, our technical schools and classes, and our evening schools. What is needed is that these shall have better opportunities of being well taught, and

better chances of coming on to the universities and colleges of university rank. For this purpose we need in these schools, above all, teachers with better pay and better prospects. It is impossible to get the best results as long as many of the teachers in these schools are badly paid, and have not as yet, like so many other teachers, even any prospects of a pension. The whole scale of salaries for teachers of all subjects, especially in the upper departments of most of these schools, must be lifted.

The effect of existing examinations upon secondary schools of all kinds, including State-aided schools, which is sometimes very injurious, is a matter of importance. We are glad that the Board of Education have had this question under consideration, and hope that remedies will be found for some of the more obvious evils that arise, at an early date. Among the rest, the Civil Service Examinations need careful consideration.

In order to bring to the universities the best boys, so many of whom now leave the State-aided secondary schools at sixteen, tempted by offers of salaries into business and industry, an adequate number of bursaries for those of from sixteen to eighteen years of age ought to be provided tenable at these schools. These should be followed by the offer of a large number of Government scholarships, adequate in value, and tenable at the universities and at colleges of university rank. For the above-mentioned purposes, probably half a million a year could be wisely spent with results to the nation of the most valuable kind. Since ours is the only college in England at which the few Government scholarships in science that exist are held, it may be desirable to state that in our experience the excellent capacity and diligence of the great majority of these scholars fully warrant the opinion that a large increase in their number for universities generally would be of great national value, and this would be especially the case if the range of selection were widened. The universities and colleges have sent a very large proportion of their students to the front, and are now greatly depleted. It is of the utmost importance that the Government should exercise immediate foresight in order that the demand for trained scientific men that must inevitably arise on the return of peace conditions may be sufficiently met. By a scheme of bursaries and scholarships it will be possible now to retain at some of the State-aided schools the best boys of the younger generation, who, after further training at the colleges, will be available for the furtherance of the skilled industries of the country—industries which are coming vitally to depend on scientific knowledge and research for their existence among us.

As to the universities and colleges themselves, no doubt part of the money for industrial research, which is administered by your Privy Council Committee, will be of real service to them. But much has to be done to put the teaching of science and technology on a proper footing at these institutions. The salaries of the junior staff are often much too low. Money, which is greatly needed for buildings, for equipment, and for research, is not forthcoming. New departments should be founded as the demands from industry increase, and a considerable number of research fellowships are required. It is estimated that the State grants to universities in Germany are about a million and a half a year, whilst in England they amount to less than a quarter of a million a year. Another quarter of a million a year could be advantageously expended by Parliament in this direction.

The Government, therefore, can, in our opinion, do great service to national education in ensuring a more adequate position for science—

(1) By removing obstacles.

(2) By giving information and guidance which may be of service to parents and to the public at large.

(3) By recommending to Parliament considerable grants of public money in the directions we have indicated.

We have ventured to lay these considerations before you because we know that, as our chairman, you are interested in these matters. Your position, too, as chairman of the Privy Council Committee on Industrial Research brings you in contact with many of these questions, the high national import of which we feel sure you appreciate. We earnestly hope that the Government may give early attention to them, for there is a general agreement that never were they of more vital importance to the nation than now.

H. B. Baker, F.R.S. . .	(Chemistry).
V. H. Blackman, F.R.S. .	(Plant Physiology and Pathology).
W. A. Bone, F.R.S. .	(Chemical Technology—Fuel and Refractory Materials).
H. L. Callendar, F.R.S. .	(Physics).
H. C. H. Carpenter . . .	(Metallurgy).
C. Gilbert Cullis. . . .	(Economic Mineralogy).
W. E. Dalby, F.R.S. . .	(Mechanical and Motive Power Engineering).
S. Dixon	(Civil Engineering).
J. Bretland Farmer, F.R.S.	(Botany).
A. R. Forsyth, F.R.S. .	(Mathematics).
A. Fowler, F.R.S. . . .	(Astrophysics).
W. Frecheville	(Mining).
Percy Groom	(Technology of Woods and Fibres).
E. W. MacBride, F.R.S.	(Zoology).
T. Mather, F.R.S. . . .	(Electrical Engineering).
J. C. Philip	(Physical Chemistry).
H. G. Plimmer, F.R.S. .	(Comparative Pathology).
R. J. Strutt, F.R.S. . .	(Physics).
Jocelyn Thorpe, F.R.S. .	(Organic Chemistry).
W. W. Watts, F.R.S. .	(Geology).
A. N. Whitehead, F.R.S.	(Applied Mathematics).

(2) Public School Reform.

In view of the grave crisis through which we are passing, we venture to ask you to join us in a demand that boys at the public schools should be properly trained in subjects essential for our national life. We consider a mastery of science and of modern languages is necessary to fit our sons to take their proper places in modern life, whether in science, commerce, or the Forces of the Crown.

A grave warning has lately been issued, signed by the most eminent scientific professors, pointing out the immediate necessity for a proper education in science; for both in the Services and in every branch of commerce is involved the use of scientific data and a sound knowledge of scientific processes, and it constitutes a grave national danger that this subject is so inadequately taught in our public schools. Few boys leave the public schools able to converse freely in modern languages; the presence of so many interpreters in the British Army is absolute evidence on this point. It is clearly seen how immensely important are these two subjects for our sons, whatever may be their future professions. The wonderful efficiency of the Germans, both in science and languages, points to the fact that their schools and universities answer these two vital requirements better than do ours. We consider that a sound knowledge of our own language and literature, modern geography, English and European history should be

taught in our public schools far more thoroughly than is done at present.

We wish to point out that the classical training in public schools is for the average boy a deplorable waste of most valuable time, and though a small minority doubtless derive advantages from the study of the classics, yet we deprecate most strongly the amount of time spent on them, and the prevalent specialisation in them on antiquated lines, with an adherence to conditions that no longer exist, while real essentials for our national success are dangerously neglected. As it is, the public-school boy, who is doing so splendidly, both as a man and a soldier, in the great ordeal through which we are passing, suffers a severe and unnecessary handicap, both in the military and commercial professions, compared with our present enemies and permanent trade competitors.

It is intended to form a deputation to approach the Conference of Headmasters, to ensure that our wishes may be carried out. Kindly state if you are in sympathy with this letter, and if you approve of such deputation. This letter has been sent to the *Times* and the parents of boys at one of the leading public schools, the headmaster of which is in favour of receiving the deputation.

AVEBURY.	ARTHUR LEETHAM.
DESBOROUGH.	J. E. THORNYCROFT.
CLAUD J. HAMILTON.	CHARLES WALPOLE.
JN. JELLICOE, Admiral.	PHILIP H. WATERLOW.

NOTES.

THE tragic news that Lord Kitchener, the Secretary of State for War, had been drowned off the Orkneys, in the sinking, either by a mine or torpedo, of the cruiser *Hampshire*, in which he was travelling with a party on a special mission to the Emperor of Russia, was received by the nation on Tuesday with deep emotion. Lord Kitchener was born on June 24, 1850, entered the Royal Military Academy at Woolwich in 1868, and obtained a commission in the Royal Engineers in 1871. In the early years of his professional career he did notable surveying work for the Palestine Exploration Fund. He was engaged from 1874 to 1878 in mapping 1600 square miles of Judah and Philistia, and in surveying part of western Palestine. Later, he did similar work for the construction of a map of Cyprus, and also took part in the survey of the Sinai Peninsula. In all the offices occupied by Lord Kitchener, and enterprises undertaken by him, he was strong with the strength of organised knowledge; and that was the secret of his success. While British Agent and Consul-General in Egypt, a post to which he was appointed in 1911, he had the Department of Agriculture transformed into a Ministry, and promoted many movements to improve the agricultural position of the country. He was also chiefly responsible for the establishment of the fine Gordon Memorial College at Khartum. His life was devoted to the service of the State, and in that service it has been lost at a time when the nation can ill afford to be deprived of genius for organised administration in every department. Two members of Lord Kitchener's party, who were lost with him, were Sir H. F. Donaldson and Mr. L. S. Robertson. Sir Frederick Donaldson was formerly Chief Superintendent of the Royal Ordnance Factories, and resigned that post in September last to become chief technical adviser to the Ministry of Munitions. He was president of the Institution of Mechanical Engineers in 1913. Mr. Leslie S. Robertson, assistant to the director of production in the Ministry of Munitions, was secretary of the Engineering Standards Committee.

THE list of honours conferred in celebration of the King's birthday includes five new peerages, seven Privy Councillorships, twelve baronetcies, thirty-one knighthoods, and a number of other promotions and appointments. Among the names of men either distinguished by their scientific work or associated closely with it, we notice the following:—*Knights*: Dr. G. T. Beilby, F.R.S.; Dr. M. A. Ruffer, C.M.G., formerly professor of bacteriology at Cairo Medical School; Dr. J. J. H. Teall, F.R.S., late director of the Geological Survey of Great Britain; Mr. R. F. Stupart, director of the Meteorological Service of Canada; and Dr. N. Tirard, medical editor of the "British Pharmacopœia" (1914), and for twenty years' secretary of the Pharmaceutical Committee of the General Medical Council. *K.C.M.G.*: Dr. W. Baldwin Spencer, C.M.G., F.R.S., professor of biology in the University of Melbourne. *Privy Councillor*: Dr. Christopher Addison, Parliamentary Secretary to the Ministry of Munitions, and late professor of anatomy in the University of Sheffield. *K.C.B.*: Mr. R. H. Rew, C.B., assistant secretary, Board of Agriculture. *C.B.*: Col. C. F. Close, Director-General, Ordnance Survey; Col. A. P. Blenkinsop, Assistant Director-General, Army Medical Service; Major P. S. Lelean, assistant professor, Royal Army Medical College; Col. C. E. Nuthall, Deputy Director-General, Army Veterinary Service. *M.V.O.*: Dr. N. D. Bardswell, medical superintendent, King Edward VII.'s Sanatorium, Midhurst, Sussex; Dr. F. S. Hewett, Surgeon Apothecary to his Majesty the King. *Companion of the Imperial Service Order*: Mr. Edmund Burke, professor of surgery, Punjab Veterinary College, Lahore, Punjab. *C.I.E.*: Mr. C. S. Middlemiss, superintendent of the Geological Survey of India.

AN important question was asked by Mr. W. H. Cowan in the House of Commons on May 23, and an unsatisfactory answer was given to it. Mr. Cowan asked the Secretary of State for the Colonies "whether his attention has been called to a communication received by the Colonial Office from the British Science Guild, dated March 12, 1915, representing that it would be proper and advisable for all departments of the Imperial Government, or of municipalities within the Empire, to make it their invariable rule and practice to pay scientific experts of all kinds for assistance rendered by them, either at committees, or by letter, or in any other way, such payments to include not only refunds for travelling expenses or other out-of-pocket expenses or maintenance, but also a proper fee for the professional assistance rendered; and whether he will appoint a committee to consider and report upon these proposals of the British Science Guild with a view to an equitable settlement of the matter." The answer of the Colonial Secretary was:—"I have seen the communication in question, and, so far as the Colonial Office is concerned, I agree with my predecessor in thinking that there is no sufficient ground for modifying existing arrangements. The second part of the question does not, therefore, arise." What we should like to know now is why the principle of gratuitous service is not applied to legal as well as to scientific experts. The only reason we can suggest is that men of science have been willing to place their knowledge at the disposal of Government departments without asking for fees, whereas members of the legal and other professions require payment for their opinions. The action of the Government in making no provision for the payment of scientific men appointed to serve on committees, or otherwise called upon for advice, influences the attitude of municipal councils and other public bodies throughout the country, and is thus largely responsible for the common view that science has no commercial value. What can be obtained for

nothing is lightly prized by the British mind, which measures the importance of advice by the amount paid for it. If science were a lucrative profession, it could command high fees for national services; but as it is not, scientific men commonly permit themselves to be exploited, and are expected to find their own reward in the interest of their work.

THE adjourned extraordinary general meeting of the fellows of the Chemical Society to consider the question of the removal of the names of nine alien enemies from the list of honorary and foreign members of the society will be held on Wednesday, June 21, at 8 p.m., in the theatre of the Civil Service Commission, Burlington House, W.

THE Paris correspondent of the *Times*, in a message dated June 4, states that the Committee of the French Senate appointed to consider the Daylight Saving Bill has, after hearing a statement submitted by M. Painlevé, adopted a resolution which empowers Parliament to advance legal time by one hour until October 1, and not for the duration of the war. The Rome correspondent of the *Times* reports that the new Summer Time came into operation throughout Italy at midnight on June 4.

THE second Japanese Supplement of the *Times*, issued on June 3, contains contributions from eminent Japanese and European authorities on Japan, among them some of scientific interest. Prof. F. Omori describes the work carried out in recent years in the investigation of volcanic and seismic phenomena in Japan. In reference to the Sakurajima eruption, in January, 1914, he notes that the total amount of ejecta from the volcano, which is only 3700 ft. in height, was sufficient to have buried the entire city of Tokyo, 31 square miles in area, to a depth of about 103 ft. An article by Mr. Robertson Scott, on enthusiasm for rural instruction, refers to the Japanese zeal for education and progress, which finds expression in the Young Men's Associations. These associations, a feature of every village, have for their object the intelligent organisation of local resources. Technical instruction is very thorough. On the subject of rice-growing, for example, Japanese authorities know not only all the East knows, but all that is known in the rice tracts of Italy and Texas. The rapid development in the past few years in the application of electricity to mechanical power, lighting, and locomotion in Japan is another illustration of the same spirit, and is dealt with by Prof. Abe, of Waseda University, writing on municipal problems. Baron Kikuchi writes in favour of the adoption of *Romaji*, or Roman letters, in place of the Chinese characters with which Japanese is now written. This reform is rendered difficult by the fact that the language is developing along ideographic, rather than phonetic, lines. New words are formed wholesale by the simple juxtaposition of Chinese characters with reference to their pictorial or symbolic meanings, and regardless of their sounds. The resulting homonymy in the literary language is the focus of the problem.

DR. J. E. SWEET, whose death is reported at the age of eighty-five, was president of the American Society of Mechanical Engineers in 1883, and was the first president of the Engine Builders' Association of the United States. From 1873 to 1879 he occupied the chair of practical mechanics at Cornell University.

MR. W. STANLEY, known by his work on long-distance light and power transmission by alternating currents, has died at his home at Great Barrington, Mass., at the age of fifty-seven. He was successively chief engineer of the Westinghouse Electric Co., the Stanley Electric Manufacturing Co., and the Stanley Instrument Co. He had been vice-president of the American Institute of Electrical Engineers.

THE death is announced, in his seventy-sixth year, of Mr. E. L. Corthell, president of the American Society of Civil Engineers, and of the American Institute of Consulting Engineers. He had been connected with some of the most important engineering enterprises, not only in the United States, but in Latin America. He was formerly consulting engineer of the Department of Public Works in the Argentine Government. One of his most conspicuous achievements was the designing of the harbour works at Tampico, which raised that port to the first rank in Mexico. As a trustee of the University of Chicago, Mr. Corthell played an important part in the foundation of the school of engineering and architecture at that institution.

THE ninety-eighth annual meeting of the Société Helvétique des Sciences naturelles will be held on August 6–9 at Tarasp-Schuls-Vulpera, in the Lower Engadine, north-east of St. Moritz, in order to facilitate visits to the Swiss National Park. There will be the following sections, as well as several general conferences:—Mathematics and astronomy; physics; geophysics and meteorology; geology and mineralogy; chemistry; botany; zoology; entomology; anthropology and ethnography; physiology and medicine. Persons proposing to communicate papers to any of the sections should write, before July 1, to the president, M. le Dr. Chr. Tarnuzzer, Chur, Switzerland.

SIR OLIVER LODGE has sent to the *Times* a translation of the letter sent by Prof. Max Planck, of the University of Berlin, to Prof. H. A. Lorentz, of the University of Leyden, in March last upon the subject of the manifesto signed by ninety-three German scholars and artists, published in August, 1914. Prof. Planck says that the terms in which the appeal was drawn up "led to mistaken conceptions as to the attitude of the signatories, as I have repeatedly discovered to my regret." As the letter has been published in Holland, it is of interest to place a full translation on record. The substance of the letter appeared, however, in the *Daily Chronicle* of April 24, and was given in NATURE of April 27 (p. 186).

MISS E. G. EVEREST, of Chippens Bank, Hever, Kent, whose bequests for a home of rest and a bird sanctuary are announced in the *Times* of June 5, was a daughter of the late Col. Sir George Everest, C.B., F.R.S., Surveyor-General of India, in honour of whom Mount Everest was named in 1856. From the terms of the will we learn that Miss Everest left her house to the National Trust to be used as a home of rest for tired brain-workers, particularly writers and artists. The land round the house has also been bequeathed to the National Trust to be used as a public park for the use of the nation, and as a bird sanctuary, where bird-life shall be encouraged, together with 8000*l*. for the maintenance of the estate. Miss Everest also left the residue of her estate, after providing for some legacies to relatives and others, for the formation and maintenance of a college in India, on lines approved by the natives, for the education of natives by natives.

A PAMPHLET on the urgent necessity of establishing an Imperial School of Technical Optics in this country has recently been issued, with a foreword by the Minister of Munitions commending the scheme to the generous consideration of all patriotic citizens who can assist in providing the requisite funds. The scheme was originally submitted by the governing body of the Northampton Polytechnic to the Technical

Education Board of the London County Council in 1903, and has been under the consideration of committees and sub-committees of the Council ever since. Both the Council and the various Government departments which have been approached in the matter admit its urgency, but the sum of 40,000*l*. necessary for carrying out the scheme has not been provided by either authority. As the scheme, if carried out, would establish an institute in Clerkenwell which would benefit the optical industries, both locally and throughout the kingdom, there seem strong reasons for making the appeal for funds over a wide area.

AN article under the title of "Air Navies of the Future" appears in the *Fortnightly Review* for June. It consists mainly of a discussion as to the likely developments in our air services in the near future. As is usually the case in such articles, the discussion is highly imaginative, and belongs rather to the realm of speculation than to that of science. The scientific statements are indeed often incorrect, as, for example, the statement that the velocity of shrapnel bullets and pieces of steel falling from a height of 20,000 ft. will be very high, and that such fragments will be highly dangerous in consequence. As a matter of fact, the limiting velocity of such bodies will rarely exceed 500 ft. per second, and the velocity on reaching the earth will be very nearly the same for all heights above 5000 ft. The one point of real interest in the article concerns the practicability of building very large aeroplanes; the writer contemplates one of 240-ft. span. There is certainly nothing inherently impossible in the building of such a machine, but it opens up a whole series of new difficulties, both aerodynamic and constructional. It seems unlikely that such aeroplanes will be built for use in the present war. The great majority of present machines are less than two tons in weight, and the five-ton aeroplane has yet to become common. It would seem that the best course to pursue is to concentrate on the construction of moderately large machines, say about five tons total weight, before attempting anything approaching a Zeppelin in carrying capacity.

IN monograph vol. xii., No. 1 of the University of California Publications in American Archæology and Ethnology, Mr. E. W. Gifford discusses the composition and age of some Californian shell-mounds. More than half their contents consist of molluscan shells, the remainder being bones, charcoal, ash, and other substances. The presence of large quantities of oyster shell (*Ostrea lurida*) points to the similarity between the conditions at the time of their growth and those of modern times. The writer enters into an interesting discussion of the age of these mounds, based largely on the assumed numbers of the population during the period of their construction. The result is that the age of one mound, that of Emeryville, appears to be from 3700 to 3300 years. The puzzle of their age, he observes, "requires for its solution every scrap of information bearing on the mounds. A knowledge of shell-mound composition, of population, of artifacts, of skeletal remains, of environment, or of food alone will not solve the problem. The proper combination of all these is necessary to gain the end."

DR. GIUSEPPE DESPOTT, in the *Zoologist* for May, deplores the destruction of bird-life which has been taking place in Malta during the last few years. Five or six species are now in imminent danger of extermination. The number of both licensed and unlicensed sportsmen and fowlers is so large that very few chances of breeding are afforded to any of the resident species. Such a thing as a "close season" is unknown in Malta, yet, remarks the author, for some species at any rate, this is "a consummation devoutly to be wished."

THE *Scientific Australian* for March gives a brief account of the new Zoological Gardens in Sydney, which are now nearing completion. About sixty acres of land, lying between the main arms of Sydney Harbour, have been devoted to this purpose. The site secured is not only one of great natural beauty, it affords also peculiarly suitable conditions for its purpose, since it comprises rocky, sheltered slopes and gullies covered with natural trees, scrub, and undergrowth. The housing of the animals will be on a generous scale and in conformity with the most recent standards —that is to say, there will be no cages in the ordinary sense, bars being replaced by deep trenches. The birds, of course, are an exception to this rule, but since the aviaries provided allow of full powers of flight, and reproduce the natural conditions of the occupants, so far as is possible, this exception is of no moment. A number of photographs afford an insight into what has been done. One of these, the elephant-house, is distinctly disappointing, the outdoor area being but a concrete yard provided with a bath in the form of a huge tub placed in the surrounding trench, and having its rim studded with spikes. This is, to say the least, inartistic.

DRS. WATKINS-PITCHFORD, A. J. Orenstein, and W. Steuart have conducted a preliminary inquiry into the prevalence of pulmonary tuberculosis among the natives working in the mines of South Africa. The conclusions arrived at are:—(*a*) That the disease in its open, or communicable, stage is far less prevalent amongst natives actually working on the mines than has been hitherto supposed; only one case, out of 400 examined, has been detected. (*b*) That the problem of the control of the disease is not so formidable as has been anticipated, and that its total eradication from the mines, therefore, appears to be a feasible proposition. (*c*) That although 107 natives were examined whose term of employment underground exceeded two years only one was found with marked X-ray signs of silicosis apparently uncomplicated by tuberculosis; it seems, therefore, fair to surmise that marked silicosis is at least not more prevalent than pulmonary tuberculosis. Various recommendations are made for the prevention of the disease (*Medical Journal of South Africa*, 1916).

THE fossil remains discovered at Piltdown are being closely studied and debated by American anatomists. Dr. Smith Woodward recognised that anthropoid characters were very clearly marked in the mandible, which he ascribed to Eoanthropus. Prof. Waterston (NATURE, November 13, 1913, p. 319) directed attention to the close resemblance of the skiagram of the Piltdown mandible to that of a chimpanzee, and regarded it as incompatible with the skull. That also is the opinion which Mr. Gerrit Miller, jun., has formed (Smithsonian Misc. Coll., 1915, vol. lxv., No. 12) after a systematic comparison of casts of the Piltdown fossils with corresponding bones of men and anthropoid apes contained in the National Museum of the United States. Mr. Miller regards the mandible as that of a chimpanzee which had its habitat in England during the Pleistocene epoch, and makes it the type specimen of a new chimpanzee species which he names *Pan vetus*, a procedure which has been already questioned by Dr. Chalmers Mitchell (NATURE, December 30, 1915, p. 480). Dr. Wm. King Gregory, of the American Museum of Natural History (*Amer. Mus. Journal*, 1914, vol. xiv., p. 189), regards the canine tooth, not as a right lower, but as a left upper member of the dental series, an opinion accepted by Mr. Miller. At a recent meeting (January 24, 1916) of the Odontological Section of the Royal Society of Medicine, Mr. W. Courtney Lyne made an elaborate analysis of the canine tooth, and gave as his opinion

that the canine tooth was "incongruous in this [Piltdown] mandible." We are of opinion that future discovery will show that all three specimens are, as Dr. Smith Woodward inferred, parts of one individual, or at least of individuals of one species. A closer acquaintance with the anatomy of anthropoid apes will reveal many similar incongruities in their structure. If mankind has been evolved from an anthropoid stock the occurrence of a combination of human and anthropoid characteristics in earlier or dawn human forms, such as occur in Eoanthropus, is just what we ought to find.

THE coast-section of Monte Hermoso, near Bahia Blanca, Argentina, has been relied on by authors who assign a high antiquity to man in South America (see NATURE, vol. xcii., p. 144). Mr. Ricardo Wichmann, however, contributes to *Physis* (tomo ii., 1916, p. 131) an account of the present condition of the exposure, and remarks that F. Ameghino must have compiled his sequence of formations from observations made at various localities. The surface of the Hermosean beds now exposed passes beneath the Puelchean without any appearance of unconformity, and the author was unable to satisfy himself that the angular fragments of quartzite, regarded by Ameghino as human implements, belong with certainty to the Puelchean horizon.

THE famous intermittent spring at Rajapur, in the Bombay Presidency, is the subject of a short paper by the Rev. Dr. A. Steichen, S.J. (Bulletin No. 14, Indian Association for the Cultivation of Science). A careful record of the flow of the spring, kept since 1883, shows that the flow lasts for sixteen to sixty-eight days, followed by a dry period of 291 to 1189 days. Dr. Steichen has compared these periods with the records of rainfall, and finds that there is no obvious correspondence between the two. This makes it unlikely that the intermittency of the spring depends on a simple siphon-like arrangement of channels connected with an underground reservoir. Dr. Steichen supposes that the channels have this arrangement, but that they become choked with deposits of lime, which stops the flow in many cases before the reservoir is empty. This, he believes, will also explain how the flow may begin as late as five months after the last drop of rain has fallen. Whether or not this is the true explanation of this extraordinary spring, there certainly is much limy matter in suspension in the early part of the flow.

IN a paper published by the University of Nevada Mr. S. P. Fergusson makes some interesting remarks on the use of high-level meteorological observations in making forecasts of temperature. His comments refer more particularly to Mount Rose, a mountain 10,800 ft. high, but he discusses the results from other high stations, such as Mount Washington, Pike's Peak, Colorado, Ben Nevis, and others. Mr. Fergusson finds some correlation between the changes on the summit and the subsequent changes in the lowlands, but on the whole the impression given is that mountain stations are not of much use for forecasting. Pike's Peak, Mount Washington, and Ben Nevis were all given up, unfortunately, for meteorology, but their use in forecasting was not sufficient to make up for the cost and difficulty of maintaining them. It is to be hoped that Mount Rose will not share the same fate. It ought not to do so, as many useful inquiries are in progress; also the records are obtained by autographic instruments, which can run for long periods, so that it is not necessary for the observers to remain always on the summit.

IN a recent note to the Faraday Society on the annealing of aluminium, Messrs. Seligman and Williams describe certain interesting anomalies in the behaviour of this metal. Hard-worked aluminium is more readily soluble in nitric acid than the annealed metal. On heating the hard-worked metal to 125° C. a definite change in the rate of dissolution is brought about. A sample of the hard-worked metal which lost 56 mgr. per 100 sq. cm. per 24 hours in 1·42 nitric acid only lost 39 mgr. when similarly exposed after being annealed at 500° C.—a decrease of 30 per cent. On annealing for 10 hours at 125° C. there was a decrease in the rate of dissolution of 5·3 per cent. It was anticipated that if the heating were prolonged the decrease in the rate of dissolution might be augmented. This was not found to be the case, but, on the contrary, as the heating at 125° C. was prolonged the fall in the rate of dissolution diminished until samples heated for 80 hours at 125° C. showed the same rate of dissolution as, or even a slightly higher rate of dissolution than, samples which had not been heated at all. These facts do not tally completely with the observations of other workers. A release of strain as indicated by Dr. Beilby should be accompanied by a reduction in the rate of dissolution, but such a release of strain would not account for the subsequent increase. The behaviour of aluminium as described above is not accounted for by any theories which have yet been put forward.

PART vi. of the Transactions of the Institution of Engineers and Shipbuilders in Scotland contains an interesting paper on the Ljungström steam turbine and its application to marine propulsion, read by Mr. R. S. Portham on March 21. In this type of turbine the flow is radial and outwards from the centre, and takes place between two discs fixed on shafts which revolve in opposite directions. Each disc is fitted with concentric rings of blades, and each ring of blades on one disc serves as guides for the ring on the other disc, which surrounds it, and is concentric thereto. The relative speed is thus doubled, as compared with a turbine having fixed guide blades, and the system therefore necessitates only one-quarter the total number of rings for the same efficiency. The illustrations in the paper are exceptionally good, and includes drawings of the largest Ljungström turbine yet constructed. This turbine develops 10,000 b.h.p. at a speed of 3000 revolutions per minute; the diameter of the outer blade ring is 34 in. only. Each of the revolving shafts is connected to an alternator, one at each end of the turbine. The condenser is placed underneath. The overall length is 24 ft., height 21 ft., and the weight of the complete turbo-alternator is 45 tons. A machine of this type of 3000 kilowatts, tested in January last with steam at 160 lb. per sq. in. superheated 280° F., gave a consumption of 11·15 lb. of steam per kw. per hour, and showed a thermodynamic efficiency of 87 per cent., as compared with the ideal engine.

IN connection with the electrification of the North-Eastern Railway, the *Engineer* for June 2 contains illustrated particulars of the goods locomotives. These were designed and built at the Darlington works of the North-Eastern Railway, under the direction of Mr. V. L. Raven. There are four enclosed motors, each driving an axle through single-reduction twin gearing. The test results are of interest. A train of 800 tons was hauled from Newport to Shildon, with stops on certain of the heaviest gradients; this train was stopped and started on a gradient of 1 in 103. The maximum draw-bar pull was 16 tons, and the average speed from Newport to Shildon was 18·3 miles per hour. On a gradient of 1 in 230 and 4·5 miles long an average speed of 23 miles per hour was obtained. The locomotive also proved capable of hauling a train of 1400 tons on the level at 26 miles per hour.

OUR ASTRONOMICAL COLUMN.

A LARGE GROUP OF SUN-SPOTS.—A remarkable spot outburst, including a great irregular active spot followed by a widespread disturbed area, was easily seen with the help merely of dark glasses on May 27, 28, and 29. Its reappearance on the eastern limb should occur about June 12 or 13.

THE TOTAL SOLAR ECLIPSE OF FEBRUARY 3, 1916.—A brief announcement in the Publications of the Astronomical Society of the Pacific (April) states that totality was observed through thin clouds by a party from the Argentine National Observatory stationed at Tucacas, Venezuela. Astronomer Chaudet had charge of the expedition, and the equipment included two cameras for coronal photography, two prismatic cameras for recording the "flash" and corona spectra, a small slit spectrograph, and a photometer.

THE SPECTRUM OF NOVA GEMINORUM NO. 2.—On a photograph taken by Messrs. Adams and Pease at Mount Wilson on the nights of February 12 and 13, with a total exposure of nine hours, the spectrum still shows Wolf-Rayet features—bright hydrogen lines and a very prominent bright band at λ 4686 are mentioned. The continuous spectrum is described as very strong (Publications, Astronomical Society of the Pacific, No. 163).

LATITUDE OBSERVATIONS BY PHOTOGRAPHY.—The work of the International Latitude Commission bids fair to be remembered as the last great piece of visual measurement. The results obtained at Gaithersburg alone would demonstrate that by means of photography here, as in so many other departments of astronomy, a precision of superior order is now obtainable. From this point of view the report by Dr. Ross might almost be regarded as epoch-making (Special Publication No. 27, U.S. Coast and Geodetic Survey, a quarto memoir of 127 pages and 18 plates). The photographic zenith tube as developed by Dr. Ross is a remarkable and ingenious instrumental achievement, and the detailed description will no doubt be read with the greatest interest by instrument-makers in this country. It consists essentially of a fixed vertical tube carrying a horizontal lens over a dish of mercury, forming an image of zenith stars just below the plane lower surface of the lens on a photographic plate. The objective end can be rotated carrying with it the plate-holder, during exposures by clockwork through a magnetic clutch at suitable rate to give point images, or by hand for reversal through 180°. The design of the lens practically eliminates the effect of errors of level. Freedom from tremor in the mercury reflector was secured by floating the amalgamated dish in a second placed on a tripod resting on a small pier independent of the main concrete base of the tube. The visual routine programme was continued without intermission, and thus a valuable comparison of the two methods has been secured. Numerically the superiority of the photographic procedure is most obvious when the results from a single pair of stars are considered, the mean accidental error of a determination of latitude being reduced from ±0·113″ to 0·060″. Especially important is the fact that although both methods yield abnormal values at times, no *systematic* differences can be traced. The comparison brings to light an error with the visual instrument that results in a progressive increase of latitude during the night. Dr. Ross is of the opinion that his work substantiates the reality of the Kimura term, and, moreover, proves the existence of "fluctuations" not due to a motion of the pole.

THE ROYAL OBSERVATORY, GREENWICH.

THE report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, was read at the annual visitation on Saturday last, June 3. The report describes the chief observations and other work carried on at the observatory during the year ending May 10, 1916. The subjoined extracts refer to a few points of particular interest.

The 28-in. refractor has been throughout the year at the disposition of M. Jonckheere, director of the Lille Observatory, whose observations have been mainly of stars which have been discovered to be double since 1905. He has spent a good deal of time in the identifications and verifications necessary to the completion of the catalogue of double stars referred to in last year's report. During the year 140 new double stars with separation less than 4″ have been discovered.

With the Thompson equatorial photographs have been continued for the determination of stellar parallax in accordance with the programme outlined in last year's report. During the year ended May 10, 1916, a first exposure has been given to 209 plates, and a second exposure, approximately six months after the first, on 226 plates. In the same period 164 plates have been measured, but the measurement has had to be discontinued. During the year thirty-seven photographs have been taken for the determination of the magnitudes of the stars in Kapteyn's selected areas. Of these thirty-four have been passed as satisfactory for measurement. Altogether of the ninety fields from declination +15° to +75°, 149 photographs of fifty-nine fields have been taken. The measurement is well advanced for the plates in zone 15°, but has made very little progress during the year.

The comparison of the position of stars given in vol. iii. of the Greenwich Section of the Astrographic Catalogue with those given in earlier catalogues for the determination of proper motions has been continued. With the exception of from 12h. to 0h. in the zone 65° to 70°, this is practically completed. A search for all stars in the *Bonn Durchmusterung* between the pole and declination 64° with large proper motions is in progress by comparison of photographs from sixteen to twenty years apart. Already 200 plates with centres at declinations 66°, 68°, 70° have been compared in this way.

Photographs of the sun were obtained on 244 days. Of these 502 have been selected for preservation, including thirty-six with double images of the sun for the determination of zero of position angle. The mean daily spotted area of the sun, which was 152 millionths of the sun's visible hemisphere in 1914, as against 7 in 1913, rose in 1915 to considerably over 700 millionths.

The mean values of the magnetic elements for 1915 and four previous years are as follows:—

Year	Declination W.	Horizontal Force in C.G.S. Units	Dip	
1911	15 33·0	0·18549	66 52 6	(3-in. needles)
1912	15 24·3	0·18548	66 51 46	" "
1913	15 15·2	0·18534	66 50 27	" "
1914	15 6·3	0·18518	66 49 27	" "
			66 51 13	(dip inductor)
1915	14 56·5	0·18494	66 51 58	" "

There were no days of great magnetic disturbance in 1915, but three were classified as of lesser disturbance.

The principal features of interest in the meteoro-

logical conditions at Greenwich during the year ending April 30, 1916, are: (i) the warm January with a mean temperature 2° higher than any January from 1841 to 1915; (ii) the great pressures of wind in the gales in the winter; and (iii) the heavy rainfall in March, the wettest March since the commencement of the Greenwich records in 1841.

The following details of the chronicle of the weather refer to the year ended April 30, 1916. The mean temperature was 49·6°, or 0·1° above the average of the seventy years 1841–1910. The highest temperature in the shade was 87·2° on June 8, and the temperature exceeded 80° on only six days, as against twenty-one in the previous year. The lowest temperature was 23·0° on November 27, and on forty days fell as low as 32·0°.

The mean daily horizontal movement of the air was 287 miles, which is three miles above the average of the previous forty-eight years. The greatest daily movement, 955 miles, was recorded on February 16, and the least, 63 miles, on October 15. The greatest recorded pressure on the square foot was 35·0 lb. on January 1; the greatest velocity in one hour 51 miles on December 27.

The duration of bright sunshine registered by the Campbell-Stokes instrument was 1476 hours, out of a possible 4473 hours, or 33 per cent. This is below the average, principally owing to a deficiency in August and March.

The rainfall was 32·17 in., or 8·05 in. above the average for the period 1841–1905. The number of rainy days (0·005 in. or over) was 168. June, with 0·56 in., was the driest, and December, with 5·20 in., the wettest month. The rainfall in March was 4·13 in.

The scientific work of the observatory has necessarily been somewhat curtailed, but it has been found possible to keep up all observations of the sun, moon, and planets; sun-spots, latitude; magnetic and meteorological registers; observations which would otherwise be permanently lost. The reductions are in some cases behindhand, and must be brought up to date later. Both the scientific staff and the workmen have made every effort to cope with the additional work caused by the absence of their normal assistance. In the course of the year six Belgian refugees have been employed at the observatory.

THE PLACE OF SCIENCE IN MODERN METALLURGICAL INDUSTRIES.

IT is significant of the position which science now occupies in the iron and steel industry that Sir William Beardmore, the head of a great armament firm in Glasgow, and the president-elect of the Iron and Steel Institute, in discussing the various factors which determine the success of any particular process, said in his recent presidential address:—"Science comes first. It is the dominant factor because it should be the beginning of all things. . . ." He went on to point out that there is, however, a tendency at the moment to neglect the other factors, and especially the attitude of labour towards improved methods of manufacture which are evolved by scientific research. This attitude amounts in many cases to an absolute refusal to utilise such improvements, and when manufacturers are charged with a lack of enterprise in not adopting modifications which are demonstrably advantageous the reason frequently is that the obstructionist attitude of labour organisations renders those improvements impossible of execution. Sir William Beardmore quite rightly insists that the question is one of profound national importance. He says:—

"The employment of the people and their well-being depend upon plenty of work. This in turn requires the maintenance of a great export trade. Efficiency and economy in manufactures can do much to win and retain foreign as well as British Imperial markets. This necessitates advance towards perfection of design and greater volume of output, through improvement in the mechanical means of production evolved by experiment. It follows that research should be a charge upon the selling price. To counterbalance this charge it is essential that the volume of output should be increased. Thus, when we reach the bedrock of industrial conditions we find that unless restrictions and limitations dictated by workers' organisations are abolished much of the gain possible to the nation due to research and experiment must be lost."

Seldom before has this point been made with such brevity and convincingness. Sir William Beardmore went on to give instances of the restrictive methods of trade unions during the war, which would be almost incredible if they were not, as they unfortunately are, amply proved to be true.

One of the best points made in his address was the clear and proper distinction drawn between the two main divisions of scientific research, which he classified as "in one case purely theoretical, almost classical; in the other as distinctly technical, or practical," each of which has its proper sphere. As regards the former, the results obtained merely indicate potentialities for the future; as regards the latter, they are generally contemporaneous with actual manufacture. No more difficult questions come up for decision than the potentialities, from a commercial point of view, of problems which have been solved in the laboratory. It is very encouraging to scientific workers in metallurgy to find such stress laid on the importance of theoretical research by a practical man of the attainments of Sir William Beardmore.

H. C. H. C.

RECENT ENTOMOLOGY.

THE Termites, or "white ants," of the United States are described by Thomas E. Snyder from the bionomic and economic point of view in Bulletin 333 of the U.S. Department of Agriculture. Three species of Leucotermes—one an introduced immigrant from South Europe—are included in the survey. The principal injury caused by the termites is the destruction of wooden buildings and other structures, but at times they devour living trees and growing crops, as well as books, papers, cloth fabrics, and stored grain and flour.

From the current number (part 3, vol. iv. B) of the *Review of Applied Entomology* it is evident that the destruction of lice infesting troops on the Eastern battlefront is a problem confronting both German and Russian army surgeons and sanitarians. From a summary of Dr. A. Hase's recent paper in the *Centralbl. Bakt. Parasit. u. Infektionskrankh* (lxxvii., 2, 1915), we learn that dirty, greasy underclothing causes a high temperature which is deterrent to lice, and we are struck by a touch of human interest rarely found in the summary of a technical paper. "The troops were all anxious to be freed from the pests with the exception of an East Prussian, who said that the little creatures reminded him of home."

A recent number (vol. iii., 3) of the *Indian Journal of Medical Research* contains some papers of interest to students of the Diptera. Major S. R. Christophers revises the list of Indian Anophelini, and describes the various stages of *Anopheles plumbeus*—a species apparently common to Europe, North America, and India—the larvæ of which were found inhabiting holes

in tree-trunks near Simla. Baini Prashad describes the microscopical structure of the halteres in mosquitoes, and discusses their use, believing that the equilibrating sense is the only function certainly attributable to the organs, which appear to have no connection with sound production or stridulation. The same author gives an account of the internal male organs in several mosquito genera. A paper of very considerable importance by P. R. Awati, entitled "Studies in Flies, II.," contains descriptions of the genital armature in several Muscid genera as compared with those of other Diptera, illustrated by nineteen clearly drawn plates. The author points out that ten segments may be represented in the abdomen of the higher Diptera, confirming the view put forward by G. H. Carpenter and T. R. Hewitt in their account of the reproductive organs of warble-flies (Hypoderma) published in 1914 (Sci. Proc. R. Dublin Soc., vol. xiv., No. 19). Mr. Awati attempts to co-ordinate the inconveniently divergent terminology which has grown up in connection with the male armature of flies studied by various writers.

The important families of the Tabanidæ and Therevidæ are dealt with in part ii. of A. White's monograph of the Diptera-Brachycera of Tasmania (Proc. R. Soc. Tasmania, 1915, pp. 1–59).

In the *Journ. Agric. Research* (vol. v., No. 12) D. G. Tower writes on the "Biology of *Apanteles militaris*," a parasite of the noctuid moth, *Heliophila* (or *Leucania*) *unipuncta*, the caterpillar of which is notorious in North America under the name of "army worm"; he describes the outlines of the embryonic development, the hatching of the larva, and its various stages. The whole life-history occupies about twenty-five days. Parthenogenesis may occur; all the offspring of virgin females appear to be males. The author discusses the function of the curious embryonic outgrowth of the hind-gut, known as the "caudal vesicle," and agrees with the view of R. Weissenberg (*Sitzb. Gesellsch. naturf. Freunde*, Berlin, 1901, 1) that it is a temporary organ of excretion.

Prof. Vernon L. Kellogg and Gordon F. Ferris publish, in the Stanford University Series (California), some valuable notes on the Anoplura and Mallophaga of North American mammals. They point out that the systematic study of the Anoplura has been markedly neglected, and furnish a diagnostic table of families and genera which will prove useful to students. The importance of these blood-sucking insects as transmitters, and possibly as alternate hosts, of Protozoa causing disease in mammals is naturally emphasised.

Students of economic entomology and of sacred history will alike be attracted by John D. Whiting's article on a recent plague of locusts near Jerusalem in the *National Geographic Journal* (Washington, vol. xxviii., No. 6). This article gives a vivid description of the locust swarms and the damage done by them to vegetation; it is illustrated by a most remarkable series of photographs. G. H. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A party of sixteen professors from various universities in France has lately visited Oxford. They received a cordial welcome, and were given ample opportunities of observing the effect of the war upon the life of the University.

Prof. A. Schuster has been appointed Halley lecturer for 1917.

Owing to circumstances connected with the war the election of a reader in geography is postponed until further notice.

BY the will of the late Miss C. E. Beckwith one-half of the residue of her estate, which amounts to about 8000*l*., is bequeathed to the Victoria University of Manchester in aid of the "John Henry Beckwith Scholarship," founded by her mother.

Science announces that by the will of the late Mr. C. W. Harkness Yale University will receive 100,000*l*. and the Harkness Fund for scientific and educational work 50,000*l*. It is also announced that a bequest of 30,000*l*. has been made to the Johns Hopkins University by Miss Jessie Gillender for the purpose of instituting organised research into the problem of epilepsy.

SOME months ago the German authorities removed to Germany as prisoners two professors of the University of Ghent, Messrs. Frédéricq and Pirenne, against whom no charge was made and no reason was given. The Dutch Government afterwards approached the German Government with the view of obtaining their release; and now a memorial has been sent with the same object to the Berlin Academy of Sciences, to other German academies and learned societies, to the senates of the German universities, and individually to a large number of German professors. There are nearly 200 signatories, all professors in Dutch universities or members of the Academy of Sciences of Amsterdam, and the list includes many of the best-known names of Dutch science. The memorialists call upon their German colleagues to obtain from the Government permission for Profs. Frédéricq and Pirenne to proceed to Holland, in order to continue their studies there. They are convinced that a refusal would seriously disappoint a large part of the Dutch nation.

UNDER the title, "Om Børns Idealer," Dr. A. Lehmann has published (*Kgl. Danske Videnskabernes Selskabs Forhandlingen*, 1916, No. 2, pp. 107) an illuminating analysis of the replies given by 4602 Danish children to the question, "What person would you wish to be like, and why do you prefer the model you have chosen?" The subjects of the inquiry were selected from five distinct types of schools, and included boys and girls of all ages from eight to sixteen. Many interesting points are brought out—for example, that although parents and other personal acquaintances fail badly to maintain their original position as the heroes of childhood, they tend to be rehabilitated in the esteem of the adolescent. Taking the results as a whole, the curves showing the preferences of the two sexes for persons, virtues and accomplishments fall rather widely apart. In a final section of the paper the author seeks to determine the influence of co-education upon the course taken by these curves, and shows that it represents something much more positive than a mere tendency to bring the views of boys and girls closer together.

DURING the past year the sub-committee on research funds of the Committee of One Hundred of the American Association for the Advancement of Science has tried to secure information regarding research funds in the United States, and particularly such as are available without substantial limitations as to the residence and so on of the person receiving the grant. A list of the more important endowments to which no restrictions are attached, with the exception of those devoted to medical research, has been prepared, and is published in the issue of *Science* for May 12. The total capital value of these endowments is 4,603,150*l*., and those funds where the endowment reaches 5000*l*. or more are as follows:—The Carnegie Institution, 4,400,000*l*.; the Smithsonian Institution, 50,000*l*.; the Engineering Foundation Board, New York City,

40,000*l.*; the National Academy of Sciences, 30,640*l.*—including the Bache Fund, 11,200*l.*, and the Watson Fund, 5000*l.*; the American Association for the Advancement of Science, 20,000*l.*, made up of the Colburn Fund of 15,000*l.* and the General Research Fund of 5000*l.*; the American Academy of Arts and Sciences, 15,760*l.*, made up of the Rumford Fund of 13,260*l.* and the C. M. Warren Fund of 2500*l.*; the California Academy of Sciences, 13,000*l.*; Harvard College Observatory Advancement of Astronomical Science Fund, 8000*l.*; the National Geographic Society Fund for Exploration and Geographical Research, 7000*l.*; the Elizabeth Thompson Science Fund, 5200*l.*; and the Archæological Institute of America, Washington, 5000*l.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 1.—Sir J. J. Thomson, president, in the chair.—Prof. H. M. **Macdonald**: The transmission of electric waves around the earth's surface. A formula is obtained for the magnetic force at any point of the earth's surface supposed imperfectly conducting when the source is a simple oscillator normal to its surface. If $\eta=(\sigma/2\lambda V)^{\frac{1}{2}}$, where σ is the specific resistance of the earth at its surface, V is the velocity of radiation in the space outside the earth, λ is the wave-length of the oscillations, and $z=(2\pi a/\lambda)$, where a is the earth's radius, it appears that, when ηz is a small quantity, the effect of imperfect conduction is to increase the magnetic force at a distance from the oscillator, the ratio of the magnetic force in this case to the magnetic force when the conduction is perfect increasing with the distance from the oscillator and diminishing with increasing wave-length. When squares and higher powers of $\eta z^{\frac{1}{3}}$ are neglected, the results at angular distances from the oscillator of 6°, 9°, 12°, 15°, 18° for a wave-length of five kilometres agree with those derived from Love's results when the square of k/m is neglected. The effect of the terms involving squares of $\eta z^{\frac{1}{3}}$ is opposite to that of the first order terms. Values of the ratio are calculated from the general formula for wave-lengths of five kilometres and two kilometres, for a wave-length of five kilometres the ratio increases almost uniformly from 1·004 at an angular distance of 6° to 1·027 at 18°, and for a wave-length of two kilometres from 1·106 at 6° to 1·082 at 18°.—Prof. W. M. **Hicks**: A critical study of spectral series. Part IV.—The structure of spark spectra. The communication deals with the nature of the structure of spark spectra, using for this purpose the spectra of silver and gold. It is found that practically the whole of a spectrum in each case is built on a similar plan. Lines differ from other lines by constant differences of wave number called links, and sets of lines are connected by these links into chains or linkages attached each to one of the ordinary series lines. These links depend on successive Δ-displacements on the series limits, where Δ is the displacement which gives the doublet separation, all of which may be calculated from data already known. The discussion is confined only to displacements on the p and s sequences. Those depending on the d sequences exist, but their discussion is postponed.—K. **Terazawa**: Periodic disturbance of level arising from the load of neighbouring oceanic tides. In Hecker's observations on the lunar deflection of gravity the force apparently acting on the pendulum at Potsdam is a larger fraction of the moon's direct attraction when it acts towards east or west than when it acts towards north or south. A similar result has been found by Michelson in his observation of the lunar perturbation of water-level at Chicago. A calculation is here made to ascertain to what extent the tilting of the ground caused by the excess pressure of the tide in the North Atlantic is important for the explanation of this geodynamical discrepancy. Replacing the North Atlantic by a circular basin of radius 2000 km., taking the position of Chicago to be 1000 km. from the coast, and the rigidity of the earth to be 6×10^{11} c.g.s., it is found that the attraction effect of a uniform tide per metre of height is about 0·0024″, while its tilting effect is as much as 0·0069″, the maximum of the direct lunar attraction being 0·017″. If the surface of tide is ellipsoidal, shelving towards the coast, nearly the same result is reached for the same mean tidal height.—E. B. R. **Prideaux**: The use of partly neutralised mixtures of acids as hydrion regulators. It has been shown that mixtures of acids have certain advantages over single acids which have been hitherto used for hydrion regulators. The principle of inserting the acids required to make the neutralisation graph more nearly linear should be capable of wide application. A mixture of phosphoric, acetic, and boric acids has been investigated, the (H′) values tabulated, and details given for the reproduction of these as standards. They were found to possess the advantages predicted.—Dr. E. A. N. **Arber**: The fossil floras of the Coal Measures of South Staffordshire. A flora of fifty-eight species is described from a new horizon in South Staffordshire, the Red Clay Series, or Old Hill Marls, of Transition Coal Measure age. A new genus, Calamophloios, and new species of Sphenopteris and Cardiocarpus are described, as well as several records new to this horizon. Ten new records are added to the known flora of the Productive Series (Middle Coal Measures), including new species of Calamites and Lepidostrobus. A large number of additional records from new localities or horizons are added in respect to fossils already known from these beds.

Faraday Society, May 9.—Sir Robert Hadfield, president, in the chair.—E. **Hatschek**: An analysis of the theory of gels as systems of two liquid phases. The generally accepted theory of the constitution of gels is that they are systems of two liquid phases. No attempts have been made to determine whether this assumption accounts for various observed properties of gels. The present paper is a mathematical investigation directed to determining whether the observed elastic properties of gels are compatible with their being composed of two liquid phases only, and it is concluded that this theory is untenable.—F. C. **Thompson**: The properties of solid solutions of metals and of intermetallic compounds. By considering the space-lattice of a solid solution of two metals as resulting from the substitution of atoms of B for an equal number of A in the space-lattice of the latter, it is possible to predict with some completeness the properties, hardness, specific volume, and electrical resistance of the alloy.—F. C. **Thompson**: The annealing of metals. After briefly considering the structural changes induced in metals and simple alloys by such processes as rolling or wire drawing, as a result of which the crystalline elements remain unchanged in hardness, the conditions governing such mechanical treatment of metals are examined.—Z. **Jeffries**: Grain size measurements in metals, and importance of such information. The author's method for measuring grain size consists in counting the grains completely included and partly included in the circular portion of an image of the specimen of standard magnification, and by means of an empirical formula determining therefrom the equivalent number of whole grains in the standard area.—Dr. F. J. **Brislee**: The changes in physical properties of aluminium with mechanical work. II.—Specific heats

of hard and soft aluminium. It was found that the specific heat of the hard aluminium was higher than for annealed, and this confirmed the view that aluminium is converted into an amorphous form by excessive mechanical work. It was further found that the specific heat underwent a change when the hard-drawn bars and wire were heated to 100° C.—Dr. R. **Seligman** and P. **Williams**: Note on the annealing of aluminium. Hard-worked aluminium which had been heated for ten hours at 125° C. was less readily soluble in nitric acid than the same metal before heating, but if the heating were continued for eighty hours, this comparative immunity from attack was lost (see p. 310).—E. J. **Hartung**: Contribution to the theory of solution. The author has tested the divergence in physical properties from those calculated by the simple mixture law shown by two completely miscible liquids which do not visibly react with each other. No simple solvate theory will suffice to explain the experimental results, even though the liquids used, with one exception, are little associated.

Physical Society, May 12.—Prof. C. V. Boys, president, in the chair.—Dr. H. S. **Allen**: The latent heats of fusion of metals and the quantum-theory. The latent heat of fusion is identified with the energy necessary to counterbalance that of a certain number of "oscillators" concerned in holding together the crystalline structure. Assuming that the energy of an oscillator having a vibration frequency ν is

$$\mathrm{RT}\times\frac{x}{e^x-1},$$

where x stands for $h\nu/\mathrm{RT}$, it is found that the atomic heat of fusion of a metal can be calculated with fair accuracy by the formula,

$$\mathrm{AL}=c\mathrm{NRT}\times\frac{x}{e^x-1}.$$

Here A denotes the atomic weight, L the latent heat, and c the ratio of the number of oscillators in question to the number of atoms. Thus, the number of oscillators in one gram molecule is Nc, where N is Avogadro's constant. It is found that to the factor c must be assigned a value which is either unity or a simple fraction. The frequency at the temperature of the melting point is calculated by means of the formula of Lindemann. The application of Debye's theory is also discussed.—T. **Smith**: Lenses for light distribution. The principle on which lenses for securing a required distribution of light from a given source have been designed is illustrated by a two-dimensional example. The principle employed is to divide the incident and emergent energy into a number of equal parts, and compute the lens system so that the rays which separate off these portions of incident light from one another are refracted as rays which separate the corresponding portions of the emergent light. The surfaces obtained are in general of varying curvature, and the lenses must, therefore, be moulded. It is shown how the effect of the finite size of the light source may be determined.—T. **Smith**: The choice of glass for cemented objectives. The strict fulfilment of the mathematical conditions for freedom from colour, spherical aberration, and coma, for objects at varying distances from a thin cemented doublet lens, necessarily demands a change in the kinds of glass as the position of the object is changed. The paper describes a method by which the proper glasses can be determined by using a glass chart on translucent paper, in conjunction with diagrams calculated for the purpose, as a slide-rule.

Zoological Society, May 23.—Dr. Henry Woodward, vice-president, in the chair.—Lieut. R. **Broom**: The structure of the skull in Chrysochloris. Two stages in the development of the skull have been studied. The earlier is that of a newly born *Chrysochloris hottentota*, the skull of which has been cut into microscopic sections and reconstructed, and a somewhat later stage of *Chrysochloris asiatica*, the skull of which has been prepared for the study of the membrane-bones. The skull is held to be in some respects highly specialised, and in others degenerate, although also retaining a number of very primitive characters.—Dr. C. W. **Andrews**: An incomplete sternum of a gigantic carinate bird from the (?) Eocene of Nigeria. Comparison with the sterna of several groups of birds leads to the conclusion that this specimen, though differing considerably from the sternum of any living member of the group, belonged to a very large representative of the Tubinares. It has about twice the linear dimensions of the sternum of an albatross, of which the spread of wing (in the flesh) was 10 ft. 8 in. It is proposed to refer this species to a new genus Gigantornis, the specific name being *G. eaglesomei*, after its discoverer.—Dr. A. Smith **Woodward**: A mammalian mandibular ramus from an Upper Cretaceous formation in Alberta, Canada. The specimen represented an opossum-like marsupial, and the author referred it to a new species of Cimolestes, named *C. cutleri*, in honour of its discoverer, Mr. W. E. Cutler. The close dental series behind the canine measured 30 mm. in length, and the molars differed from those of the two known species of the genus in their relatively less elevated trigonid. The fourth premolar was a large, tumid, laterally compressed cone, with one well-separated posterior cusp.—V. **Lutshnik**: (1) A list of Carabidæ collected in Chopersk district, South Russia; (2) a new species of the genus Platysma from China; and (3) notes on species of Platysma from Australia.—E. G. **Boulenger**: A new lizard of the genus Phrynosoma.—Dr. R. W. **Shufeldt**: Notes on cases of albinism seen in American animals.

PARIS.

Academy of Sciences, May 22.—M. Camille Jordan in the chair.—G. **Bigourdan**: The immediate collaborators of Peiresc. These included Jean Lombard, Simon Corberan, and Antoine Agarrat, and an outline of the astronomical work of each is given.—E. **Cahen**: The general reduced numbers of Hermite.—T. **Bialobjeski**: The influence of the pressure of radiation on the rotation of the celestial bodies.—T. **Peczalski**: The effect of temperature on the structure of paraffin. A study of the effects produced on paraffin wax by prolonged exposure to temperatures slightly below its melting-point. For a paraffin wax the density of which was originally below 0·900 the density increased with prolonged heating, and this change is accompanied by a considerable reduction in the electrical conductivity of the material.—M. **Siegbahn**: The existence of a new group of lines (series M) in high-frequency spectra. The lines were produced by uranium. On account of the absorption of these lines by air the spectrograph was in a vacuum, the crystal used being a plate of gypsum. This series has also been found to be represented in the spectra of thorium, bismuth, lead, thallium, and gold.—A. **Schidlof** and A. **Targonski**: The Brownian movement of particles of oil, tin, and cadmium in different gases and at different pressures. From the results obtained experimentally it is concluded that Einstein's theory of Brownian motion applies to all spherical particles without restriction. It also applies to non-spherical particles of not too irregular form, whatever may be the gaseous medium.—F. **Pisani**: A new method for the estimation of fluorine. The method is based on the insolubility of thorium fluoride in solutions faintly acidified with acetic or nitric acid. 0·01 per cent. of fluorine can be detected. The application of the method to various minerals containing fluorine is

described.—M. and Mme. F. **Moreau**: The phenomena of sexuality in lichens of the genus Solorina.—J. **Glover**: An electrical apparatus for auscultation, clinical exploration, and experimental physiology.—P. **Lecène** and A. **Frouin**: Experimental researches on the mechanism of encystment of foreign bodies and on latent microbism.—M. **Marage**: The classification of deaf soldiers according to their power of hearing. A criticism of the current methods for determining deafness in the French Army. These are shown to be faulty in three respects.

BOOKS RECEIVED.

Quartic Surfaces with Singular Points. By Prof. C. M. Jessop. Pp. xxxv+197. (Cambridge: At the University Press.) 12s. net.

British Birds. Written and illustrated by A. Thorburn. Vol. iii. Pp. vi+87+plates. (London: Longmans, Green and Co.) 1l. 11s. 6d. net.

Hart's Note-Book for Navigators and Others. (Colchester: Benham and Co., Ltd.)

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. v., Potash, Felspar, Phosphate of Lime, Alum Shales, Plumbago or Graphite, Molybdenite, Chromite, Talc and Steatite (Soapstone, Soap-rock, and Potstone), Diatomite. By Dr. A. Strahan and others. Pp. iv+41. (London: H.M.S.O.; E. Stanford, Ltd.) 1s.

Men of the Old Stone Age: their Environment, Life, and Art. By Prof. H. F. Osborn. Pp. xxvi+545. (London: G. Bell and Sons, Ltd.) 21s. net.

Central American and West Indian Archæology. By T. A. Joyce. Pp. xvi+270. (London: Philip Lee Warner.) 12s. 6d. net.

The Breath of Life. By J. Burroughs. Pp. x+295. (Boston and New York: Houghton Mifflin Co.; London: Constable and Co., Ltd.) 5s. net.

The Psychology of Relaxation. By Dr. G. T. W. Patrick. Pp. viii+280. (Boston and New York: Houghton Mifflin Co.; London: Constable and Co., Ltd.) 5s. net.

The *Athenaeum* Subject Index to Periodicals, 1915. Fine Arts and Archæology. Second edition. Pp. 33. (London: The *Athenaeum*.) 1s. 6d. net.

Department of Statistics, India. Agricultural Statistics of India, 1913–14. Vol. i. Pp. x+415. (Calcutta: Superintendent Government Printing.) 2.8 rupees.

Costruzioni di Strade e Gallerie. By Prof. Ing. S. Rotigliano. Pp. xxiii+808. (Milano: U. Hoepli.) 18 lire.

The Life of Inland Waters. By Prof. J. G. Needham and J. T. Lloyd. Pp. 438. (Ithaca, N.Y.: Comstock Publishing Company.)

A Manual of Practical Physics. By H. E. Hadley. Pp. viii+265. (London: Macmillan and Co., Ltd.) 3s.

Synchronous Signalling in Navigation. By Prof. J. Joly. Pp. 64. (London: T. Fisher Unwin, Ltd.) 3s. 6d. net.

Wild Flowers of the North American Mountains. By J. W. Henshaw. Pp. xv+383. (London and New York: McBride, Nast and Co., Ltd.) 10s. 6d. net.

Forty-seventh Annual Report of the American Museum of Natural History for the Year 1915. Pp. 194. (New York.)

The Cicindelinæ of North America as arranged by Dr. W. Horn in Genera Insectorum. Edited by E. D. Harris and C. W. Leng. Pp. vi+23. (New York: American Museum of Natural History.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 8.

ROYAL SOCIETY, at 4.30.—Further Determinations of Direct Osmotic Pressures: The Earl of Berkeley and E. G. J. Hartley.—The Magnetic Shielding of Large Spaces, and its Experimental Measurement: Prof. E. Wilson and Prof. J. W. Nicholson.—Motion of Solids and Fluids when the Flow is not Irrotational: G. I. Taylor.

ROYAL INSTITUTION, at 3.—Chamber Music and its Revival in England: Sir Alexander Mackenzie.

MATHEMATICAL SOCIETY, at 5.30.—The Classification of the Integrals of a Linear Partial Differential Equation of the First Order: Prof. M. J. M. Hill.—(1) Non-absolutely Convergent, not necessarily Continuous, Integrals; (2) The Convergence of Fourier Series and of their derived Series: Prof. W. H. Young.—The General Linear Differential Equation: Dr. S. Brodetsky.—A Note on the Series $\Sigma a_n \sin n\theta$ and $\Sigma a_n \cos n\theta$, where (a_n) is a Sequence of Positive Numbers tending steadily to Zero: A. E. Jolliffe.

INSTITUTION OF MINING ENGINEERS, at 10.45 a.m.—The History of the Safety-Lamp: Prof F. W. Hardwick.—The Health of Old Colliers: Dr. J. S. Haldane.—The Estimation of Moisture in Coal: T. F. Winmill.—(1) The Absorption of Oxygen by Coal. VIII. and IX.; (2) The Oxidation of Pyrites: T. F. Winmill.

OPTICAL SOCIETY, at 8.—Modern Technical Applications of Radium and other Luminous Substances: F. Harrison Glew.

FRIDAY, JUNE 9.

ROYAL INSTITUTION, at 5.30.—Eyesight and the War: Dr. E. Clarke.

ROYAL ASTRONOMICAL SOCIETY, at 5.—An Inequality in the Period of the Eclipsing Variable RZ Cassiopeiæ: R. S Dugan.—A Probable Relation between the Changes in Solar Radiation and the Melting of the Polar Snow Caps of Mars: E. M. Antoniadi.—Micrometrical Measures of Double Stars: Rev. T. E. R. Phillips.

MALACOLOGICAL SOCIETY, at 8.—Note on *Erato guttula*, Sow.: J. R. le B Tomlin.—An Undescribed Ammonoid from the Lower Greensand (Aptian) of Kent: G. C. Crick.—*Helix scytodes*: Prof. G. K. Gude.

SATURDAY, JUNE 10.

ROYAL INSTITUTION, at 3.—Folk-lore in the Old Testament: Sir J. G. Frazer.

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THURSDAY, JUNE 15, 1916.

POSITION AND PROSPECTS OF CHEMICAL INDUSTRY.

RECENT communications to the British and German Press show that already the opposing forces of the trade war of the near future are manœuvring into positions favourable for the prosecution of their militant operations. This contest, when opened, will be most severe in the domain of the coal-tar products, in which hitherto the German manufacturers have maintained a very lucrative monopoly. The German newspapers of the first week in May contain references to an amalgamation of the producers of aniline dyes, drugs, and other fine chemicals. These manufacturers, who have made enormous profits since the outbreak of war, have been impelled to take this step by the fear of foreign, and especially British and American, competition. Seven large chemical factories formerly belonging to three different groups have, while retaining a certain degree of independence, formed a new "community of interests," in which the units will share their "experience," so that all products will be manufactured by at least two of them simultaneously. The strength of this amalgamation is to be gauged, not only by its capital of more than 11,000,000*l.*, but by its unequalled combination of financial, technical, and scientific efficiency.

The advocates of a chemical directorate for chemical factories are met in England with the statement that in Germany the technical directors are only apparently supreme, and that the higher policy is in reality dictated by bankers and financiers. This view is contradicted by *Vorwärts,* which states that the German chemical trust is the only one over which banks and financiers have no control, because this chemical industry has always made such huge profits that it is now supplied with ample funds for extension. The German Press is very optimistic as to the success of the new organisation in maintaining the ascendancy in dyes and fine chemicals of all descriptions. This sanguine anticipation is based on the fact that chemical science has hitherto been treated with indifference in England. The *Neueste Nachrichten* of Munich asks, "Do the English really believe that, by means of customs and patent laws, by waging an economic war, and by boycotting our goods, they can counterbalance German intelligence?" *Vorwärts,* from the point of view of the worker, deplores the formation of the German trust on the ground that a chemist or chemical workman incurring the displeasure of one unit of the group is not likely to find further employment in German chemical industry.

In England the situation in regard to the grouping of coal-tar industries is still obscure, but certain significant developments have recently taken place. The State-fostered organisation has at length admitted a chemist to its board of directors, a step the desirability of which has been repeatedly urged in the columns of NATURE and other organs of the Press. But although British Dyes, Ltd., of Huddersfield, have in the difficult circumstances of the war made commendable progress, it is hard to see how this single organisation can hope to compete with the giant trust of Germany, with its vast resources and accumulated experience. Government help should be forthcoming for all willing workers in this field, and attempts at the boycott and repression of individual firms or chemists should, in the public interest, be rigorously suppressed. The friendly rivalry between Yorkshire and Lancashire, which is a perennial feature of life in the industrial North, is being extended into chemical industry by the recent noteworthy achievements of the firm of Messrs. Levinstein, Ltd., of Manchester. Although excluded from the Governmental favours monopolised by their trade rivals, this firm now claims to manufacture one-half the quantity of dyes formerly imported into this country from Germany. Throughout the war Messrs. Levinstein have supplied the Admiralty and War Office with enormous quantities of blue and khaki dyes, and their colours have rendered possible the equipment of the Belgian and Italian armies with dyed uniforms. The scientific side of this enterprise will be greatly strengthened and vitalised by the appointment to the headship of its research department of Prof. Green, formerly professor of tinctorial chemistry in the University of Leeds, and the discoverer of primuline, dianthine, and other important dyes.

In addition to the two oldest-established firms, many other industrial undertakings are developing extensively in the direction of manufacturing dyes and other coal-tar products. These firms include, not only those in the colour trade before the war, but also munitions factories at present engaged in the production of high explosives, the directors of which are looking to the manufacture of dyes and fine chemicals for a profitable employment of their numerous workers and extensive plants. Finally, there is an increasing tendency on the part of academic chemists to launch out in the direction of preparing urgently needed chemicals, such as dimethylaniline and β-naphthol. Some of these workers are spending time and money on products which are already being successfully manu-

factured by the larger firms. During the war period the famine in chemicals enables the "small men" to make a profit, even on their necessarily restricted operations. It is, however, doubtful whether these praiseworthy enterprises will be able to withstand the stress of the forthcoming trade war. The collapse of these smaller undertakings will spell ruin to some, and will inevitably entail losses of capital and industrial energy. What is urgently needed at present is an intelligent co-ordination of these useful and patriotic activities.

The question of dyes is only part of the larger problem of coal-tar products, in which Germany has invested a capital of 80,000,000*l*. The cost of producing the best modern synthetic dyes can never in this country be brought to the German level until the utilisation of numerous by-products is placed on a sound economic basis. The solution of this intricate problem demands years of patient and often unproductive research, systematic organisation of chemical investigation, co-ordination of national resources in men and materials, and extensive industrial development, supported and defended impartially by a scientifically informed branch of the Government.

There is no evidence that anything systematic is being attempted. These sporadic and disorganised enterprises will prove futile against our scientifically organised opponents. Success in this strenuous struggle will come to British chemical industry only if the tactics of the unsupported industrial sniper are replaced by the far-seeing strategy of an organised general staff of qualified chemists and manufacturers.

An important step in this direction was taken on May 23 at a meeting, held at Burlington House, of the representatives of one hundred leading firms engaged in chemical industries, when a motion was adopted to the effect that "it was desirable that British firms engaged in the chemical and allied trades should form an association to promote closer co-operation and to place before the Government the views of the chemical trade generally; to further industrial research; and to facilitate closer co-operation between chemical manufacturers and various universities and technical schools."

At this meeting the chairman, Dr. Charles Carpenter, president of the Society of Chemical Industry, pointed out that at present we had no organisation to meet foreign competition when war was over. Mr. Brunner, M.P., mover of the resolution, stated that, although the war had shown that science was invaluable in time of war, yet the Government, by their lack of knowledge of chemistry, had kept them back in more ways than one.

The opinion was also expressed that this organisation of chemical industries should be regarded as a necessary step in the direction of affiliating chemical manufacturers with a more comprehensive union embracing allied trades. How extensive and diverse are the ramifications of the colour industry will be seen when due consideration is given to the trades affected directly by the abnormal price of dyes. Although textile manufacturers have been hardest hit, the blow has also been felt by paint- and colour-makers, paper-makers, ink-manufacturers, leather-workers, soap-boilers, coach-builders, sealing-wax makers, and the linoleum, celluloid, and engineering trades. If further evidence be needed to emphasise the claim of the synthetic dye manufacturers for impartial and extensive Government support, it is the cardinal fact that this trade is a key industry in the general scheme of national defence. An outstanding example may be cited. One of the large German dye groups was, before the war, employing 10,000 operatives in the production of colours and other fine chemicals. To-day there are 14,000 workers in these factories making high explosives.

LAMB'S HYDRODYNAMICS.

Hydrodynamics. By Prof. Horace Lamb. Pp. xvi+708. Fourth edition. (Cambridge: At the University Press, 1916.) Price 24*s*. net.

THAT this work should have already reached a fourth edition speaks well for the study of mathematical physics. By far the greater part of it is entirely beyond the range of the books available a generation ago; and the improvement in the style is as conspicuous as the extension of the matter. My thoughts naturally go back to the books in current use at Cambridge in the early 'sixties. With rare exceptions, such as the notable one of Salmon's "Conic Sections," and one or two of Boole's books, they were arid in the extreme, with scarcely a reference to the history of the subject treated or an indication to the reader of how he might pursue his study of it. At the present time we have excellent books in English on most branches of mathematical physics, and certainly on many relating to pure mathematics.

The progressive development of his subject is often an embarrassment to the writer of a textbook. Prof. Lamb remarks that his "work has less pretensions than ever to be regarded as a complete account of the science with which it deals. The subject has of late attracted increased attention in various countries, and it has become correspondingly difficult to do justice to the growing literature. Some memoirs deal chiefly with questions of mathematical method and so fall outside the scope of this book; others, though physically important, scarcely admit of a condensed analysis; others, again, owing to the multiplicity

of publications, may unfortunately have been overlooked. And there is, I am afraid, the inevitable personal equation of the author, which leads him to take a greater interest in some branches of the subject than in others."

Most readers will be of opinion that the author has held the balance fairly. Formal proofs of "existence theorems" are excluded. Some of these, though demanded by the upholders of mathematical rigour, tell us only what we knew before, as Kelvin used to say. Take, for example, the existence of a possible stationary temperature within a solid when the temperature at the surface is arbitrarily given. A physicist feels that nothing can make this any clearer or more certain. What is strange is that there should be so wide a gap between his intuition and the lines of argument necessary to satisfy the pure mathematician. Apart from this question it may be said that everywhere the mathematical foundation is well and truly laid, and that in not a few cases the author's formulations will be found the most convenient starting point for investigations in other subjects as well as in hydrodynamics. To almost all parts of his subject he has made entirely original contributions; and, even when this could not be claimed, his exposition of the work of others is often so much simplified and improved as to be of not inferior value. As examples may be mentioned the account of Cauchy and Poisson's theory of the waves produced in deep water by a local disturbance of the surface (§ 238)—the first satisfactory treatment of what is called in Optics a dispersive medium—and of Sommerfeld's investigation of the diffraction of plane waves of sound at the edge of a semi-infinite screen (§ 308).

Naturally a good deal of space is devoted to the motion of a liquid devoid of rotation, and to the reaction upon immersed solids. When the solids are "fairly" shaped this theory gives a reasonable approximation to what actually occurs; but when a real liquid flows past projecting angles the motion is entirely different, and unfortunately this is the case of greatest practical importance. The author, following Helmholtz, lays stress upon the negative pressure demanded at sharp corners in order to maintain what may be called the electric character of flow. This explanation may be adequate in some cases; but it is now well known that liquids are capable of sustaining negative pressures of several atmospheres. How, too, does the explanation apply to gases, which form jets under quite low-pressure differences?[1] It seems probable that viscosity must be appealed to. This is a matter which much needs further elucidation. It is the one on which Kelvin and Stokes held strongly divergent views.

The later chapters deal with vortex motion, tidal waves, surface waves, waves of expansion (sound), viscosity, and equilibrium of rotating masses. On all these subjects the reader will find expositions which could scarcely be improved, together with references to original writings of the author and others where further developments may be followed.

It would not have accorded with the author's scheme to go into detail upon experimental matters, but one feels that there is room for a supplementary volume which should have regard more especially to the practical side of the subject. Perhaps the time for this has not yet come. During the last few years much work has been done in connection with artificial flight. We may hope that before long this may be co-ordinated and brought into closer relation with theoretical hydrodynamics. In the meantime one can scarcely deny that much of the latter science is out of touch with reality.

RAYLEIGH.

[1] The fact that liquids do not break under moderate negative pressure was known to T. Young. "The magnitude of the cohesion between liquids and solids, as well as of the particles of fluid with each other, is more directly shown by an experiment on the continuance of a column of mercury, in the tube of a barometer, at a height considerably greater than that at which it usually stands, on account of the pressure of the atmosphere. If the mercury has been well boiled in the tube, it may be made to remain in contact with the closed end at the height of 70 in. or more" (Young's "Lectures," p. 626, 1807). If the mercury be wet, boiling may be dispensed with, and negative pressures of two atmospheres are easily demonstrated.

PREHISTORY IN INDIA.

Madras Government Museum. The Foote Collection of Indian Prehistoric and Protohistoric Antiquities. Notes on their Ages and Distribution. By Robert Bruce Foote. Pp. xv + 246 + plates 64. (Madras: Government Press, 1916.) Price 14*s*. 8*d*.

THIS book must be welcomed, in default of any systematic study of the prehistoric remains. The late Mr. Bruce Foote had, for more than forty years, been collecting stone implements as a bye-issue of his professional work as Government geologist. In 1901 he published a valuable catalogue of the collection in the Government Museum at Madras. Since then he drew up the present catalogue of his own collection, which has lately been added to that museum. The photographic plates here are sufficiently good, and a large map of India (in end pocket) shows seven distinct classes of prehistoric sites by coloured signs. The arrangement by locality is useful for the future worker, but it makes the grasp of the historical results more difficult to follow.

The main question, for which no answer seems forthcoming, is that of the relative and absolute age of prehistory in India. Some assurances given here are surprising, as that in India "the iron industry is one of great antiquity (far greater, indeed, than in Europe—*e.g.*, at Hallstatt or La Tène)" (p. 25). Also that "the iron workers were the direct successors and probably lineal descendants of the neolithic people" (p. 3). Further, that only in "the Later Iron Age we reach a period in which we find Indian man had become acquainted with three additional metals—gold, copper, and tin" (p. 3). We see here a position so different from that of western Asia and Europe that some convincing evidences are needed. Yet, unhappily, there is no stratified site to prove the succession of periods (p. 29), nor is there a single evidence stated of the relative ages. The mention of iron in the Ramayana is quoted, but that is only of the fourth century B.C. No

literary evidence is possible of iron being earlier in India than in Europe, as the oldest works, the Vedas, are, in their present form, centuries later than iron was known in Europe. So far as internal evidence goes the copper axes are closely like those of the copper age in Italy, while the iron tools have much affinity with those of the Roman period. Thus, in the absence of any evidence of position, we are thrown back on the suggestion that the iron is later than that of Europe, and succeeded the use of copper. That stone tools continued in use until iron was made, and so are found contemporaneously with it, is what is known in other countries where copper and bronze long preceded iron, without ousting the use of stone.

It will be seen, then, how the whole basis of Indian prehistory needs clearing up and defining by strict evidence fully recorded. In a land where the wealth of historic buildings far exceeds the provision for archæology, it is a reproach to the Government and not to the archæologist that the prehistory is left unsettled. We need first a firm basis of record of all that is contemporary with finds of Roman coins and early buildings, and before that a series of stages of groups (linked together by their resemblances in pottery, stone, and metal work) which could be projected one beyond the other into the unknown.

Some details will be of general interest. The palæolithic tools are of quartzite, the neolithic of traprock (p. 17). There are no perforated celts (p. 18). The stone axes are set through wooden handles, secured from splitting by iron ferrules (plate, p. 60). Amazon stone is found in veins in granite (p. 23), as in the Egyptian source, the site of which is unknown. W. M. F. P.

WOMEN AND THE LAND.

Women and the Land. By Viscountess Wolseley. Pp. xi+230. (London: Chatto and Windus, 1916.) Price 5*s*. net.

ONE of the characteristic features of the nineteenth century was the movement from the country to the city, and now in the twentieth century the process is being reversed, and there is a strong tendency to move back once more to the land. As yet it is only in the tentative stages; people go out into the country to retire, to keep a poultry farm, or to set up a fruit farm, and there is much to be learned, and still more to be done, before the movement becomes sufficiently well organised to make it a really potent factor in the national life. It is quite clear that women must take part in it, and perhaps the most notable feature in the whole business is the way in which they are organising themselves for the purpose. We may take it that, once being organised for the exodus, they are not likely to disorganise for the settlement, and the new rural community will therefore be very different from the old. The basis of the women's organisation is educational, and therein it differs from the ordinary man's "back to the land" movement, the basis of which is mainly political. It is this that makes it so full of portent for the future.

Having found the agricultural colleges, with one or two exceptions, barred against them, some of the more enterprising and far-seeing spirits proceeded to set up colleges of their own. Amongst them is Lady Wolseley, who founded the institution at Glynde some fourteen years ago, and in the book before us she sets out the results of her experience and makes various suggestions for the future.

Lady Wolseley does not contemplate that women shall be the labourers, but rather the leaders, in the new community. She considers them well fitted for two classes of work: supervisory or advisory work for educated women belonging to the middle and upper classes; and light manual work connected with the dairy, poultry, bees, fruit, the house, etc., for the village girl. Facilities for training the advisers already exist, but little has yet been done towards teaching the more manual work.

The author maintains, however, that it is not sufficient merely to turn women into the country; some sort of common tie must be kept up, and for this purpose the best arrangement is considered to be a colony on co-operative lines, where it would be possible not only to make good business arrangements for buying and selling materials, produce, etc., but where also opportunities for social life would be afforded. The details are discussed in successive chapters. The most striking feature of the book is the seriousness with which the whole subject is taken, and the clear recognition that a second education is the only sure basis for success. E. J. R.

OUR BOOKSHELF.

The Chemists' Year-book, 1916. Edited by F. W. Atack. Vol. i., pp. 354. Vol. ii., pp. 355–990. (London and Manchester: Sherratt and Hughes, 1916.) Price 10*s*. 6*d*. net.

THIS handy book belongs to a type of chemical literature which is more common in Germany than with us. Such examples of it as we have hitherto possessed have been mainly translations from the German, and have been prepared for simultaneous issue in both countries, usually at the beginning of each year. Almanacs and year-books are common enough in all grades of business, but it is only within recent years that they have been adapted to the requirements of professional chemistry. They are essentially designed to meet the wants of practising chemists and public analysts, to whom it is a great convenience to have numerical tables, mathematical constants, and useful memoranda arranged for them in a handy and easily accessible form.

Mr. Atack's compilation is a much more comprehensive production than is usual in a work of this kind, and includes quite a remarkable body of information ranging from a list of notable dates in the history of chemistry to the pharmaceutical names of synthetic compounds and trade names of drugs, together with analytical tables, conversion tables for weights and measures, five-figure

logarithms, natural sines and tangents, specific gravity and hydrometric tables, and tables of solubilities of a wide range of substances. As a rule, care has been shown in selecting the latest and best authorities, and the whole has been put together in a convenient form. The proofs have evidently been very well read, as the book is remarkably free from typographical errors. The editor deserves great praise for the thoroughness with which he has done his work, and the book, we trust, will find a place in the laboratory or on the desk of every chemical consultant.

The Purpose of Education: An Examination of the Education Problem in the Light of Recent Psychological Research. By St. George Lane Fox Pitt. New Edition. Pp. xxviii+144. (Cambridge: At the University Press, 1916.) Price 2s. 6d. net.

FEW people, it is to be feared, even among teachers, ever really face the question: "What ought education to aim at?" This book will at least stimulate to such inquiry, and it points the way in the right direction. The author, accepting the new conception of human personality which psychical research has brought about, considers that the proper purpose of education is the harmonising of psychic phases, the study of the laws governing them, finding their interpretation in the art of living and "giving them synthetic expression in the growth of character." To put the matter in definite form, the manufacture of noble souls is the right aim, and the right method is the inculcation of high ideals. The Sermon on the Mount is the acme of truth and beauty. It urges us to rely less on the seen, the concrete, the physically tangible, and more on the spiritual side of our natures, unmanifest to our senses, but very real and permanent, eternal while the other is temporal. Thus we gain true security and everlasting peace. The present state of Serbia, Poland, and Belgium shows what is the result when education in a neighbour-State becomes materialistic, aiming only at physical efficiency and power. The war has its lessons: we must learn them.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Gravitation and Temperature.

As the outcome of a very delicate systematic series of experiments (*Phil. Trans.*, 1916) it is announced by Dr. P. E. Shaw that "when one large mass attracts a small one the gravitative force between them increases by about 1/500 as temperature of the large mass rises from, say, 15° C. to 215° C."; that is, it increases by about $1 \cdot 2 \times 10^{-5}$ of itself per degree Centigrade. This seems to be a very startling result, at any rate if temperature is merely the expression of internal molecular motions, as, indeed, Dr. Shaw seems to admit.

By Newton's principle gravitation between masses must act reciprocally; the result, therefore, means that the astronomical mass of a body must increase with temperature by $1 \cdot 2 \times 10^{-5}$ of itself per degree Centigrade. The pendulum experiments of Bessel and recent determinations by Eötvös seem to establish proportionality between gravitational mass and mass of inertia, irrespective of temperature, well beyond these limits. Thus inertia also would have to increase with temperature; and when a freely moving mass is becoming warmer its velocity must be diminishing, for its momentum must be conserved. A comet like Halley's is heated upon approach to the sun; thus it should suffer retardation in the approaching, and acceleration in the receding, part of the orbit, enough probably to upset existing astronomical verifications. Indeed, as regards change of inertia, we can recall the principle applied by Prof. Joly to the question whether chemical change involves change of mass, viz., that every mass around us is moving through space with the velocity of the solar system, and a sudden rise of temperature in a body must therefore involve a violent kick if its inertia is thereby sensibly altered.

Electrodynamic theory does establish unequivocally an increase of inertia of a body arising from gain (δE) of thermal or electric energy; but this is only of amount $\delta E/c^2$, where c is the velocity of radiation, and so is minute beyond detection. The question whether there is also an equivalent increase in gravitational mass evades discussion until some link connecting gravitative and electric forces has been established.

J. L.

Cambridge, June 5.

A Plague of Caterpillars.

WITH reference to what has appeared in the public Press relative to the devastation caused by caterpillars to the oak trees at Ashtead, you may be interested to know that some three or four years since a similar occurrence took place in the oak plantations in Richmond Park.

The denudation of the trees was so severe that in the spring of 1913 H.M. Office of Works consulted Mr. Maxwell Lefroy, the famous entomologist of the Royal College of Science, with the view of stamping out the pest. Eventually it was decided to spray the trees with chromate of lead at such a time that the young caterpillars, on hatching out, should have only poisoned food. The spraying operations were carried out by portable high-pressure pumping apparatus loaned by myself, self-supporting telescopic ladders being provided to reach the tree-tops some 40 ft. from the ground.

This was, I believe, the first occasion on which attempts were made to spray such large trees, and there is not much doubt that the oaks at Ashtead could be treated in a similar manner.

It is, of course, now too late in the season to undertake preventive measures, but if spraying were undertaken early next May I have not much doubt that the pest could be eradicated.

J. COMPTON MERRYWEATHER.

4 Whitehall Court, S.W., June 7.

The Black-eared Wheatear: A New Bird for the Irish List.

ORNITHOLOGICAL readers of NATURE will no doubt be interested to learn that a black-eared wheatear (*Œnanthe hispanica*) was obtained on Tuskar Rock, Co. Wexford, on May 16, by Mr. Glanville, principal lightkeeper. There are two races of this bird, an Eastern and a Western, each of which exhibits dimorphism of plumage, the

throat in some being whitish, in others black. The bird now obtained from Tuskar Rock displays the latter character in its plumage, and is indeed the black-throated wheatear (*Saxicola stapazina*) of earlier writers. When I find time to compare it I hope to be able to assign it to its racial form. In the meantime it seems desirable to announce its occurrence without delay *as a bird quite new to Ireland*. I have to express my great gratitude to Mr. Glanville for so kindly sending me this interesting specimen in the flesh for identification and investigation. C. J. PATTEN.

The University, Sheffield.

EXPERIMENTAL BIOLOGY.

WE use in our title the term Experimental Biology, which requires some apology, as a convenient label for an interesting bundle of thirteen papers by Jacques Loeb and Hardolph Wasteneys. They give an account of important experiments bearing on a variety of puzzling biological problems. (1) Loeb showed many years ago (1889) that some animals orient themselves in relation to a luminous object so that their plane of symmetry falls into the direction of the rays of light, and suggested that this reaction was comparable to the heliotropic reaction of plants. In 1897 he brought forward evidence in support of the view that the action of light in evoking a heliotropic reaction is chemical, and this theory is now confirmed by additional facts.

According to the law of Bunsen and Roscoe, the photochemical effect of light is equal to the product of the intensity into the duration of illumination, and this has been shown to hold for the heliotropic curvatures of plants (Blaauw and Fröschl) and of hydroids (Loeb and Ewald). Furthermore, it has now been shown by Loeb and Wasteneys that the region in the spectrum most efficient in the production of heliotropic curvature is almost the same for hydroids (Eudendrium) and for oat seedlings. The investigators suggest that there are two types of photosensitive substance, one with a maximum sensitiveness (or absorption) in the yellowish-green, and the other with a maximum of sensitiveness in the blue. The first type is represented by visual purple, and a photosensitive substance of this type occurs in Chlamydomonas (often claimed as a plant), in Daphnia, and in many other organisms. The second type of photosensitive substance occurs in Euglena, in Eudendrium, and in many plants. Thus the distribution of the type of substance does not correspond to the boundaries between plants and animals.

(2) In another series of experiments Loeb inquires into the conditions which determine or prevent the entrance of the spermatozoon into the egg. It is well known that a fertilised egg is non-receptive to other spermatozoa. What is the nature of this block? It is not due to the changes underlying the development of the egg, for if the eggs of a sea-urchin are induced to develop by the methods of artificial parthenogenesis, a spermatozoon may still enter the egg or an individual blastomere. By simply altering the alkalinity of the sea-water Loeb can make a sea-urchin ovum receptive or non-receptive to the spermatozoon of a starfish; this depends on some rapid alteration of a physical property of the surface of the ovum. And the ingeniously worked-out experimental argument points to the conclusion that a block of this sort is induced when a spermatozoon fertilises an egg.

But what of the more positive side of the question? There is a widespread belief that a spermatozoon shows a positive chemotropism for the appropriate ovum, but Loeb finds no proof of this in sea-urchins. The motility brings the spermatozoon fortuitously near the egg; the vibrations may assist in boring and in fixing the spermatozoon to the surface of the ovum until other forces, such as surface-tension, come into play. What is certain is that the spermatozoon cannot enter the egg unless physical conditions at the boundaries of egg, spermatozoon, and surrounding solution are right. It must be noted, however, that a sea-urchin spermatozoon becomes more active when it comes near an egg of its own species, and Loeb suggests that this activating effect of the egg upon spermatozoa, being most rapid as regards spermatozoa of its own species, is a means of preventing hybridisation. In other words, the activating influence of the egg has some degree of selective specificity.

(3) In a third set of experiments Loeb tackles the problem of the degenerate condition of the eyes in some cave animals, such as fishes and salamanders. Though a few zoologists cling to the "natural" interpretation that the "blindness," which differs considerably in degree, is due to the hereditary accumulation of the results of disuse, the difficulties in the way of accepting this Lamarckian view are very serious. It has been assumed, therefore, that the blindness of some cave animals began as a germinal variation or mutation. But confidence in the legitimacy of this assumption has been lessened by the meagreness of our knowledge as to the occurrence of variations in the direction of optic degeneration. Very welcome, therefore, are Loeb's recent experiments which show that degeneracy of the eye can be readily induced by influences affecting the condition of the egg or the earliest stages of development. Thus, embryos with degenerate eyes can be produced by fertilising the eggs of *Fundulus heteroclitus* with the spermatozoa of *Menidia*.

Since in these cases there is usually no circulation in the feeble embryos, the inference is suggested that the anomalous condition of the eye may be due to lack of circulation. Blind embryos of the pure breed of Fundulus may be produced by the addition of KCN to the sea-water; and a short exposure of the fertilised ova to temperatures between zero and 2° C. results in abnormal embryos, a certain percentage of which will show degenerate eyes. It is interesting to learn that lack of light does not, in the case of Fundulus, influence the development of the eye. From Loeb's experiments it is not to be argued that the blindness of cave animals

arose in any of the ways mentioned. What the experiments show is the legitimacy of the assumption that blindness may arise as a germinal variation or factorial mutation. And that is considerable gain.

(4) Other experiments deal with the influence of balanced and non-balanced salt solutions upon the osmotic pressure of the body liquids of Fundulus; with the functional importance of the ratio of concentration of antagonistic salts with univalent and bivalent cations; and with the membrane formation in the eggs of the sea-urchin.

(5) In an illuminating essay on the stimulation of growth, Loeb states his view that it may be inherent in an unfettered cell to grow and divide eternally in appropriate conditions, as is illustrated, indeed, by both Protozoa and Protophytes. This capacity may depend on the presence of synthetic ferments or "synthetic mechanisms" which are formed from the food taken up by the cells. But few cells show this capacity, and the question rises, What stimulates growth and what keeps the cell at rest? In most cases the unfertilised ovum soon dies, in spite of its potential immortality. If it is fertilised or treated with the methods of artificial parthenogenesis, it divides actively. The condition of rest or activity in this case depends, according to Loeb, upon the condition of the cortical layer of the egg and the alteration in the rate of oxidations connected with this condition. We do not know whether the resting of body-cells is determined by conditions identical with those determining rest in the egg.

We know, however, that specific substances circulating in the blood can induce certain resting cells in the body to grow, and that these substances differ apparently for different types of cells. It may be that in the body substances antagonistic to these may enforce the inactivity of the cells.

(6) In a vigorous and characteristic paper entitled "Mechanistic Science and Metaphysical Romance," Loeb argues that the demonstration of the reality of molecules and the counting of their number in a given mass of matter "puts science for a long time, and probably irrevocably, on a mechanistic basis. It marks, perhaps, the greatest epoch in the history of the theory of cognition. It enables and compels us to define the task of science differently from Kirchhoff, Mach, and Ostwald. We may say it is the task of science to visualise completely and correctly the phenomena of nature, of which our senses give us only very fragmentary and disconnected perceptions. We must try to visualise the numerous hidden processes and conditions connecting the disconnected phenomena we perceive." We cannot argue the question here, but we must be allowed to enter our dissent from Loeb's conclusion that the activities, development, and evolution of organisms can be adequately and exhaustively described in mechanical terms, or in chemico-physical terms (which are regarded by many as ideally mechanical). We are convinced that in living creatures new aspects of reality have emerged which transcend mechanistic formulation. We are inclined to think that further study of the metaphysics which this consummately ingenious experimenter slangs so vigorously might render him less confident in the stability of his mechanistic system. We yield to none in our admiration of his illuminating scientific achievements, but we cannot agree with his philosophy. J. A. T.

THE GREAT CANADIAN REFLECTOR.

Very satisfactory progress is being made on the great 72-in. reflecting telescope which is being constructed for the Canadian Government, and is now approaching the final stages of erection and adjusting.

The mounting has been completed by the Warner and Swasey Co., of Cleveland, Ohio, and has been temporarily erected at their factory. Exhaustive tests have shown that the operating mechanism works perfectly. The entire mounting weighs about 120,000 lb., of which the moving parts weigh upwards of 80,000 lb., and yet it moves with the greatest smoothness and ease. The worm wheel for driving the telescope weighs more than 4000 lb., and yet it may be turned readily on its axis with the finger. By means of seven electric motors and conveniently situated stationary and portable switchboards, the instrument can be set, driven, and guided with the utmost facility. Indeed, the immense machine can be operated and handled with greater ease than many small telescopes. The mounting will be taken down and shipped to the observatory as soon as the erection of its dome is sufficiently advanced.

The optical portions of the telescope are being made by the John A. Brashear Co., of Pittsburgh, Pa. The principal part, namely, the great mirror, 73 in. in diameter, is also well advanced. It has been brought to the spherical form, and will be given the paraboloidal form and finally polished as soon as the firm has completed a large plane mirror which is required for testing it. The smaller optical parts are all completed, and have been attached to the mounting. It is hoped that the mirror will be ready as soon as the mounting is erected and in condition to receive it, which will be about the end of the summer.

The pier to support the telescope was completed last autumn. It is made of reinforced concrete, and is of massive construction. The walls of the surrounding circular steel building, 66 ft. in diameter, were erected during the winter, and the dome, constructed by the Warner and Swasey Co., which will rest and revolve upon these walls, arrived in Victoria, B.C., about the end of March, and is now being put in place. The shutter opening is 15 ft. in width. The dome has been very carefully designed to work in conjunction with the telescope, and it is confidently believed that it will be the most complete and convenient of any in the world.

One of the observers' residences has been erected, but none of the other buildings required have yet been begun. It is hoped, however, that

everything will be ready to begin regular observing with the magnificent equipment next spring, by which time the preliminary experimental work of adjusting will be completed.

The rapid progress on the telescope is largely due to the excellent plans which were prepared by Dr. J. S. Plaskett in consultation with the Brashear and the Warner and Swasey companies. Dr. Plaskett will have charge of the instrument when completed.

SIR FREDERICK DONALDSON, K.C.B.

AS announced in last week's NATURE (p. 307), Sir Hay Frederick Donaldson, an engineer of distinction, perished in the disaster to H.M.S. *Hampshire*, on June 5, when accompanying Lord Kitchener as a representative of the Ministry of Munitions with the special rank of Brig.-General. He held successively the positions of deputy-director-general, chief mechanical engineer, and chief superintendent of the Royal Ordnance Factories, Woolwich. He was associated with, and largely responsible for, the great improvements in the power and mechanism of naval and land artillery during the last twenty years. Since the beginning of the war his energies were severely taxed in assisting to meet the demand for an enormously increased supply of munitions of every description, and in augmenting the productive capacity of the Royal Arsenal. Some months ago he was appointed chief technical adviser to the Ministry of Munitions.

Born in 1856, at Sydney, Sir Frederick was the second son of Sir Stuart A. Donaldson, the first Premier of New South Wales. He was educated at Eton, Trinity College (Cambridge), Edinburgh, and Zurich. He was a pupil of the late Mr. Webb at the L. and N.W. Railway works at Crewe. Afterwards he was executive engineer on the West of India Portuguese Railway and Harbour, engineer-in-charge of No. 1 Section of the Manchester Ship Canal, and engineer-in-chief to the London and India Docks Joint Committee. Then in 1897 he went to Woolwich, where his chief work was accomplished.

In addition to his professional avocations, Sir Frederick took a great interest in the scientific side of engineering. He was a member of the Council of the Institutions of Civil Engineers, Mechanical Engineers, and of the Iron and Steel Institute. In 1913 and 1914 he was president of the Institution of Mechanical Engineers, took an energetic part in guiding its affairs, and delivered an admirable address dealing with the education and the workshop training of engineers. He was actively interested in the work of the Engineering Standards Committee, and was chairman of the committee on screw threads and limit gauges. The investigations of this committee have certainly led to increased accuracy of workmanship and to extensions of the modern system of manufacturing machines with parts interchangeable without needing adjustment. At its instance a lathe of the highest accuracy was installed at the National Physical Laboratory, which can be used in correcting lathe leading screws. In 1909 Sir Frederick gave an instructive lecture at the Institution of Mechanical Engineers on "The Interchangeability of Screw Threads." He also proposed a scheme for the registration of the results of scientific researches carried out in private laboratories and those attached to factories and manufacturing works, with the object of preventing reduplication of effort. Valuable as such a system would be, it has not so far been found practicable.

To great ability and wide engineering knowledge Sir Frederick added unfailing tact and great courtesy and charm of manner, and enjoyed the esteem of all who were associated with him. His colleagues mourn his loss, which to them and to the country is irreparable.

MR. LESLIE S. ROBERTSON.

APPOINTED to the staff as a representative of the Ministry of Munitions, and with the special rank of Lieut.-Col., Mr. Leslie Robertson met his death on the ill-fated mission of Lord Kitchener to Russia. He was born in India in 1863, the youngest son of Sir W. R. Robinson, K.C.S.I., Governor of Madras, who resumed an earlier family name in 1898. He was educated in Germany and at King's and University Colleges in London. He was technically trained in the works of Messrs. Denny and Co., Dumbarton, and Messrs. J. I. Thornycroft, Chiswick. Then he was in private practice for a time, during which he represented in this country the important firm of Normand, of Havre.

In 1901 he became secretary to the Engineering Standards Committee, the work of which he carried on for fourteen years with an enthusiasm and ability to which much of its success is due. Founded initially to standardise rolled sections of steel, the work of this committee has extended to nearly all the materials largely used in engineering, and to a variety of manufactured products from locomotives to glow-lamps. Further, it has standardised tests and specifications. An army of engineers, users, and manufacturers, including representatives of the War Office and Admiralty, formed its sectional committees, giving their services gratuitously, and greatly helped by the tactful arrangements made by Mr. Robertson to economise their time. The results are becoming of increasing importance from an international point of view. In 1912 Mr. Robertson was secretary to delegates sent by the Board of Trade to a congress in New York of the important International Association for Testing Materials, founded by Bauschinger in 1884.

In August, 1915, Mr. Robertson was appointed assistant director of production in the Ministry of Munitions, and was concerned with organising the production of the metal components of ammunition. One of his colleagues at Armament Buildings writes that "his almost unique knowledge of the capacity of the workshops of Great Britain and of the men in charge of them was invaluable in negotiations, leading to the enormous

output which has been accomplished. Especially helpful was his knowledge of men and their business capacity, and the Ministry owes much to him in this, not only in the particular section he had in charge, but throughout the organisation."

He was the author of papers on "Propulsion on Canals" and "Light Railways," and translated "Marine Boilers," by M. Bertin, Chief Constructor of the French Navy.

NOTES.

WE learn with deep regret that Prof. Silvanus P. Thompson, F.R.S., died on June 12, a little before midnight, at his residence in West Hampstead, after only two days' illness.

THE meeting of Scandinavian naturalists, to be held in Christiania on July 10–14, will be attended by not fewer than 500 members. The papers announced number 142.

THE Bill to advance legal time by one hour during the period from June 14–15 to September 30–October 1 has been passed by the French Senate and the Chamber of Deputies, so that French time now corresponds to British Summer Time.

THE rescue of the twenty-two members of Sir Ernest Shackleton's expedition who are now marooned on Elephant Island is to be undertaken by a steam-trawler belonging to the Fisheries Department of Uruguay. The vessel was built in Aberdeen in 1906 for the North Sea fishing fleet. She was expected to leave Buenos Aires on June 9, and to call at the Falkland Islands, where she would be joined by Sir Ernest Shackleton, on June 13. They are nearer than South Georgia to Elephant Island, which, if all goes well, should be reached in four days from the Falklands. The trawler has been fitted with wireless apparatus, and communication will be maintained with her by a British auxiliary cruiser, which will be stationed in Drake's Strait. It is therefore possible that news of the rescue of Wild and his comrades may be received on June 18, and the party may be back in South America before the end of the month. With regard to the Ross Sea, the Secretary of the Admiralty announces that the rescue of the men left ashore when the *Aurora* was blown away from her winter quarters at Cape Evans will be carried out at the end of this year in the *Aurora*, with the co-operation of the Governments of the Commonwealth of Australia and the Dominion of New Zealand.

WE regret to learn that among the officers killed in the naval action in the North Sea on May 31 was Commander H. L. L. Pennell, R.N., who lost his life by the sinking of H.M.S. *Queen Mary*. Commander Pennell, who was thirty-four years of age, joined the *Britannia* in 1898, and became a midshipman next year. In 1903 he was promoted lieutenant, and after several years' distinguished service was selected by the late Capt. R. F. Scott to be one of the officers of the *Terra Nova* in the British Antarctic Expedition of 1910. When Capt. Scott and the main wintering party had landed in McMurdo Sound early in 1911, Lieut. Pennell took the *Terra Nova* east, along the Ross Barrier, and found Amundsen in the *Fram* at his winter base. Lieut. Pennell afterwards landed the second wintering party at Cape Adare, and in the following summer moved them further south. He was in command of the *Terra Nova* throughout the expedition, and it was he who, on the return to New Zealand, discovered the westward trend of the north coast of Victoria Land, which he named Oates Land. On his return from the Antarctic in 1913 Lieut. Pennell was promoted commander in the Navy.

THE *Morning Post* of June 5 contains some of the impressions of life in Germany, particularly of the scientific activity, received by a neutral lately returned from Berlin. The general view of the greater scientific efficiency of Germany is confirmed, and the German interest in science as a source of profit is contrasted with the study of science for its own sake in this country. We learn that German chemists introduced a gaseous arsenic compound for military use which could be fired into the enemy ranks in cases which exploded on arrival. Fortunately, however, for the Allies' troops, the gas decomposes and becomes innocuous when fired from a gun. The manufacture of synthetic rubber (particularly for motor-car tyres) is said to be a great success, but the process is a competitor with the manufacture of explosives for the limited supply of benzol. The neutral observes that the scientific experiments with bread have been less encouraging, its quality having become worse, whilst the indigestible portion has increased in amount this year. The people are suffering privations from insufficiency and poverty of food, the effects being loss of weight and an illness caused by unwholesome diet. Great hopes are reposed in the coming harvest, towards the abundance of which science has done its share by providing nitrates manufactured from atmospheric nitrogen.

IT is worthy of note that the Addington-Wickham bourne is now flowing, a phenomenon of very rare occurrence. The last flow of any magnitude was in 1883, when more than three million gallons of water per day were gauged by Mr. Baldwin Latham near Hayes. Since that date two water pumping-stations have been built in this valley, the combined pumping of which has resulted in the present bourne being reduced to 1,600,000 gallons a day, as measured recently by Mr. Latham. The bourne is interesting as being essentially the highest source of the Ravensbourne. It now commences in springs in a field near to Addington village. Many springs can be seen feeding it in the fields in the valley, and it has filled up two large gravel pits near the Hayes railway. It passes under the railway and, crossing the road, reaches what for many years has been the source of the Ravensbourne. The present source, although now on the chalk, has to well up through a considerable thickness of gravel. It is surmised that in times when the Croydon and other bournes are out, this one remains invisible owing to its flowing over the chalk but under the gravel, and only on exceptional occasions it appears at the surface. It would seem that a good deal of underground solution is going on, judging from the manner in which the banks around the spring-heads have been let down below the surrounding levels.

THE "Report of the Committee on Edible and Oil-Producing Nuts and Seeds" of West Africa [Cd. 8247], just issued, affords an interesting glimpse of the changed attitude of the Government towards science and industry, brought about by the war. The exports of oilseeds and oils from British West Africa in 1913 were valued at 7,228,000*l*., and of this amount Germany took no less than 3,869,000*l*., chiefly in the form of palm kernels, the crushing of which for oil and cake she had practically monopolised. The outbreak of war placed British West African exporters in a serious position, the usual channel for more than half their exports of oil and oilseeds being stopped. The story of how this difficulty was met and a new British industry in the crushing of palm kernels organised is told in Prof. Dunstan's introduction to

"Oil-seeds and Feeding-Cakes" (London: John Murray, 1916), and need not be repeated here. The action taken was so successful that when the Oilseeds Committee began its investigations in June, 1915, it was in the fortunate position of merely having to consolidate an industry instead of having to create one. Full justice is done in the report to the work of the Imperial Institute, the British agricultural colleges, and the Board of Agriculture, all of which took part in the scientific, technical, and commercial investigations which led to this successful result. The Committee makes four recommendations with a view to the retention of the new industry in British hands after the war, and of these two are to be put into immediate action, in accordance with instructions contained in a despatch from Mr. Bonar Law to the Governments of Nigeria, Gold Coast, and Sierra Leone, printed with the report. The first of these is the imposition of an export duty of 2*l.* per ton, or more if necessary, on all palm kernels exported from West Africa to ports outside the British Empire. The second recommendation is that the West African Departments of Agriculture and Forestry should take measures to continue and extend their investigations of the oil palm, and that "these measures should be taken in co-operation on the scientific and technical side with the Imperial Institute, by which admirable work has been done in the past in connection with the oil palm, and to which much of the existing knowledge of the palm and its economic products is due."

The care expended on the well-being of the animals in modern zoological gardens is well illustrated in the forty-fourth annual report of the Zoological Society of Philadelphia, which we have just received. As in the Gardens of the Zoological Society of London, the most searching post-mortem examination is instituted in the case of every death, and as a result discoveries are made the importance of which is not to be measured by their immediate value to the society concerned. In the present report the most interesting items are a mysterious epizootic among the waterfowl, and of an arachnoid parasite in the lungs of monkeys. The lesions they produce simulate, and may be mistaken for, tubercles. But their presence does not seem seriously to affect the host. The original habitat and mode of transmission are unknown, but no fewer than four different species have been described, and have been taken from monkeys both in India and Africa, as well as from captive specimens.

Dead bodies of the short-tailed petrel, to the number of many hundreds, have periodically been found along the beach at Ulladulla, New South Wales, and a like mortality prevails on some islands a few miles off the mainland. Naturally such discoveries have given rise to much speculation among ornithologists. As a rule it is attributed to disease, starvation, or storms. But Mr. G. Basset Hull, in the *Emu* for April, advances what seems to be a much more probable explanation—to wit, that these are the victims of the struggle for breeding territory with the larger and more powerful wedge-tailed petrel. Support is lent to this view from the fact that on one island, where the wedge-tailed species were breeding in large numbers, no burrows were found tenanted by the short-tailed species, but their dead bodies were found outside the burrows of their larger rivals. If, indeed, the smaller species is harried, buffeted, and finally driven off in an exhausted state by the larger, then the struggle for existence in the case of the short-tailed petrel must be indeed severe. It is to be hoped that an attempt will be made to set this matter at rest, for it raises a point of quite exceptional interest.

In the *Australian Zoologist* (vol. i., part 3) Dr. A. S. Le Souef, the director of the Zoological Gardens, Sydney, records some interesting colour variations of opossums of the genus Trichosurus. The general coloration of the common opossum (*Trichosurus vulpecula*) is grey above, whitish below. The variants on this are rufous, black, and fawn, but it seems difficult to associate such variations with environmental conditions. Thus "brown" coloured individuals are most common in Tasmania, and appear to be confined to the moist, heavily timbered districts; but on the mainland brown-coloured specimens are very common, "particularly in the drier districts." The descendants of the Tasmanian opossum turned out at Lyttelton, New Zealand, some five and twenty years ago already show variation from the typical form, since the animals have become darker and the fur longer and less dense. The author suggests that Mr. Oldfield Thomas, of the British Museum, was in error when he described the mountain opossum (*T. caninus*) as brown in colour. This hue appears only in the black opossum after it has been partially depigmented by immersion in spirits. The existence of the black opossum is here recognised for the first time, being designated a distinct subspecies (*T. caninus nigrans*). This well-marked subspecies "is found in the heavy coastal scrubs in north-eastern New South Wales and southern Queensland."

In the report of the South African Museum for 1915, just issued, Dr. L. Péringuey, the director, relates a very extraordinary occurrence. While the troops of the Union were camped in the wide sand-belt of Luderitzbucht and Swakopmund, waiting to advance inland, there appeared, suddenly, after heavy rains—a thing almost unheard of in those parts—all along the line, immense swarms of moths. The fact is the more extraordinary and mysterious since these sands are almost void of visible vegetation. That they were brought by the wind from inland Dr. Périguey considers improbable. They disappeared as rapidly as they came. Samples which were sent to the museum proved to consist of no fewer than twenty species of Noctuidæ. In this report mention is also made of the fossilised skull of the "Boskop" man found in the Transvaal, and of fragments of limb-bones, probably of the same skeleton. This skull, which seems to be remarkable for its great length, has not yet been described in detail. It is much to be hoped that this will soon be done. A mandible found in the river-gravels at Harrismith, in the Orange Free State, and stone implements found in another locality in the Orange Free State, are also mentioned among the acquisitions for the year deserving special mention.

In an article under the title "The Reflex as a Creative Act" (Bull. Imp. Acad. Sci., Petrograd, November, 1915), the eminent Russian biologist S. I. Metalnikov discusses the nature of reflex action, and contests the position of those biologists and physiologists who maintain (*a*) that reflex action presupposes the existence of a central nervous system; (*b*) that reflexes are unconscious and involuntary; (*c*) that they are uniform and invariable. If, he says, we concede these premises we are at the outset brought up against a whole series of difficulties. In many of the lower Invertebrata, and in all unicellular organisms, the most careful research fails to reveal any central nerves, yet they react to various stimuli no less than the higher organisms. Further, we can never determine by direct observation whether a reaction is voluntary or involuntary. And, lastly, even as no two organisms are exactly alike, so there are no

two absolutely similar reactions. The reactions of Protozoa are never uniform. Even in Amœba they are so varied as to be scarcely ever twice alike. After describing some experiments on Paramœcium, the author maintains that every reaction produces a definite modification in the living tissue, and may therefore be considered as closely connected with the creation of the personality, and he concludes a closely reasoned dissertation in these words:—"The life of every organism is an uninterrupted creation, and this individual creation, the cause of endless variety, is but a small part of that larger creative cycle which we call evolution."

DR. JOHS. SCHMIDT, in vol. xxiii. of *Rapports et Procès-verbaux du Conseil International pour l'exploration de la mer*, gives a further contribution of his studies on the natural history of the eel. The paper deals with the question of the existence of "smaller species" or "races" of the European eel, and with the distinguishing features of this species, of the American and of the Japanese eel. The characters investigated include the number of vertebræ, the number of rays in different fins, and the number of branchiostegal rays. The conclusion arrived at is that, whilst the three species investigated are clearly marked the one from the other, it has not been found possible to distinguish between different "races" of the European eel. The most convenient character is the number of vertebræ. The author brings forward a point of considerable biological interest by comparing the condition found amongst the eels with that found in the viviparous blenny (*Zoarces viviparus*), a species having about the same number of vertebræ as the eel. He finds that samples of Zoarces taken from closely adjacent localities in Danish waters may differ one from another as regards number of vertebræ to a higher degree than does the European eel from the American eel in respect of the same character, and that, whereas *Zoarces viviparus* in the north of Europe is divided up into numerous distinctly different stocks or populations according to locality, all the eels of Europe are identical. This difference the author considers must be due to the fact that all European eels have the same origin in the spawning grounds of the Atlantic Ocean. The blenny, on the other hand, is viviparous and has no pelagic stage, so that it is highly localised, and specimens collected, for instance, in the inner waters of a fjord may have a lower number of vertebræ than those taken at the mouth. Whether this is due to "genotypic differences" or to the immediate effect of varying external conditions, the author hopes to make a matter of direct experiment.

THE Government of Madagascar has issued the "Annuaire Général de Madagascar et Dépendances" for 1916. The war has affected the size of this year's volume, which takes the form of a supplement and corrections to the issue for 1914. Among a great deal of matter the most useful from a geographical point of view is the account of the railways, to which is added a large-scale map. There is also a short account of the chief roads, and of the navigable waterways. The last part of the volume is occupied with trade statistics.

VOL. 1 of Agricultural Statistics for India, 1913–14, which deals with British India, demonstrates a noteworthy steadiness of agricultural operations during recent years. In the preceding decade the total area cropped, the areas sown with rice, millets, wheat, sugar, cotton, jute, and oil-seeds, suffered but slight fluctuations. The cropped area which has been irrigated and the area devoted to food crops have both increased, the former by 30 per cent. In the whole of India 80 million acres are sown with rice, which is ten times the acreage in Japan; 29 million acres with wheat, which is only exceeded by the wheat acreage of the United States; and 25 million acres with cotton, which is two-thirds of the cotton acreage of the United States. About one-eighth of the Indian area is cropped more than once. The exceptions to the general conditions are indigo and opium, which have declined in acreage by about a half since 1909. In the latest year the area devoted to cinchona was increased by a tenth; this increase is due to a great extension of the cultivation in Bengal, the acreage having declined in Madras, which is the other chief growing district. Nearly half the sugar-cane is produced in Agra, where the area under this crop is being increased. A third of the cropped area in Madras and the United Provinces, a half in the Punjab, and three-quarters in the district of Sind depend upon irrigation from canals, tanks, or wells for their water supply.

THE fifth volume of the special reports on the "Mineral Resources of Great Britain" has just been issued by the Geological Survey (London: H.M. Stationery Office and E. Stanford, Ltd.; price 1s.). This is rather more miscellaneous in scope than its predecessors, and deals with a number of mineral substances between which there is neither economic nor geological relationship, namely:—Potash-felspar, phosphate of lime, alum shales, plumbago, molybdenite, chromite, talc and steatite, diatomite. It will be noted that some of these substances, like alum shales, are being worked to-day; others, like plumbago, have given rise to important mining operations in the past; and others again, like molybdenite, never have been worked in this country, nor does there seem to be much probability as regards this mineral that workable deposits are likely to be discovered. It might be suggested that in such a case as the last-named rather more attention might be devoted to the known occurrences within the Dominions of Greater Britain. The first article in the volume is perhaps the most interesting, because the discovery of an economically workable British source of potash is one of the great needs of the moment. It is curious to note that in the section dealing with the extraction of potash from felspar foreign authorities are freely quoted, but no reference is made to an exhaustive recent article on the subject in the Journal of the Society of Chemical Industry (April 30, 1915). If the present work serves to direct the attention of chemists and geologists to this important subject, nothing but good can result; indeed, it seems strange that, at a moment when committees by the score are being created to advocate researches into all manner of subjects, some of them, perhaps, of but remote practical interest, the important question of potash supply has not received more attention. It would indeed be a wise move if the Board of Agriculture would offer a handsome prize as an inducement to chemical investigators to work at this problem, which, although admittedly difficult, should not be incapable of solution.

AN interesting addition to the existing literature on the eruptions of the volcano Stromboli has come to our notice in the form of a collection of papers published in a particularly interesting number of the *Atti dei Lincei*, xxv. (1), 5. It was after an interval of twenty-four years that an eruption characterised by copious flows of lava made its first appearance in June, 1915, and Prof. Gaetano Platania and Prof. Gaetano Poute were deputed to study the phenomena, being assisted in this work by an American vulcanologist, Mr. F. A. Perret. The papers here referred to describe separately the individual experiences of the three observers, Profs. Platania and Poute contributing their own observations, while those of Mr. Perret are detailed in a paper by Prof. A. Riccò.

Although figures of equilibrium of rotating liquids have already been fairly thoroughly studied by the late Sir George H. Darwin and others, a fresh method of approximate solution of the problem, by Prof. A. Liapounoff, appears in the Bulletin of the Petrograd Imperial Academy of Sciences, vi. (April 15). The principal feature of this method is that, after obtaining an equation which is not in itself soluble, the author substitutes an approximate formula, which may be taken as equivalent to the previous one to a sufficient degree of accuracy within the limits involved in the calculation and overcomes the mathematical difficulties.

The May issue of Section A of the Proceedings of the Royal Irish Academy contains three papers by Prof. McClelland and his assistants which deal with methods of production and detection of ions in the atmosphere. In the first of the series it is shown that leaves exposed to the ultra-violet light of an electric spark between aluminium electrodes show the photoelectric effect to an extent which in some cases is a tenth of that shown in the same circumstances by copper. A cold-water extract from the leaves may show an activity a third of that of copper, while an acetone extract shows no activity. A few drops of the acetone solution will, however, render a large volume of water strongly active. The other papers relate to the ions produced when water is sprayed into air or air bubbled through mercury. In both cases the saturation curves of the air show that there are four or five kinds of ions present in it with mobilities which vary from those of the large Langevin ions to those of the ordinary small ions, while there appear to be present in addition at least two types of ions with still greater mobilities.

A very timely and valuable essay on "Zinc, its Production and Industrial Applications," by Mr. J. C. Moulden, was recently read in abstract at a meeting of the Royal Society of Arts. This essay was the result of a prize founded by Mr. Reginald Le Neve Foster in memory of his father, a former secretary of the society from 1853 to 1879, the subject being determined by the council. The publication is one of considerable length, and extends over two weekly issues of the society's journal. It opens with an account of the physical and chemical properties of the metal, and then passes to a consideration of its history, from which it appears that although it played no part of any importance in the economics of the ancients it was known to them both as the metal and in the form of alloys. The first zinc smelting works were established in this country at Bristol in 1743 by John Champion. He also secured a patent in 1758 for the winning of brass and zinc from blende as a substitute for calamine, which hitherto had been the sole source of the metal. Succeeding sections deal with zinc ores, their nature, occurrence, and distribution, and the metallurgy of the metal. The essay should be of great service, appearing, as it does, at a time when the possibility of establishing a great zinc industry in this country is being carefully considered.

The U.S. Bureau of Standards has recently issued a circular (No. 58) entitled "Invar and Related Nickel Steels," which is mainly a compilation from sources, many of them inaccessible, as to the properties of nickel steels, with particular reference to the properties of the non-expanding alloy known as "invar." This should prove to be an exceedingly useful publication. After a brief historical introduction the following properties receive attention: (*a*) Reversible and irreversible nickel steels, their equilibrium diagram, microstructure, and constitution. (*b*) Magnetic properties. (*c*) Electrical properties. (*d*) Thermal expansion. (*e*) Transitory length variations following temperature changes. (*f*) Permanent changes in length at constant temperature. (*g*) Elongation of invar with time. (*h*) Rapidity of invar transformations. (*i*) Effect of composition on instability. (*j*) Reproducibility of properties of invar. (*k*) Density. (*l*) Mechanical properties. (*m*) Resistance to corrosion. (*n*) Applications, sources of supply, and bibliography. The knowledge of ferro-nickels goes back to the year 1822, when Stodart and Faraday published a paper. It was in 1889 that James Riley, of Glasgow, described, before the Iron and Steel Institute, his epoch-making investigation which disclosed the remarkable mechanical properties of nickel steels. His alloys contained various amounts of nickel up to 49 per cent., which had been prepared for him in France by Marbeau. The above circular may be obtained free by addressing a request to the Bureau of Standards.

OUR ASTRONOMICAL COLUMN.

Comet 1916*b* (Wolf).—The following ephemeris is a continuation of that given in Nature of June 1 for Greenwich midnight:—

	R.A. h. m. s.	Decl ° ′
June 21	12 29 31	+4 45·4
25	30 14	4 44·2
29	31 10	4 41·6
July 3	32 18	4 37·6
7	33 39	4 32·3

Correction.—The comet's distance on July 3 will be 400 million miles, *i.e.* ten times the figures given by error in the note referred to above.

The Solar Activity.—Another very large, active, spot disturbance has appeared. The following spot has developed considerably since Monday. The larger spot has been seen with ease, using a small glass magnifying five times. Extremely bright faculæ have been noticed (June 13) on the eastern limb.

The New Draper Catalogue.—The seventieth annual report of the Harvard Observatory contains the extremely interesting announcement that the first step in the formation of the monumental New Draper Catalogue—the classification of the stellar spectra—has been completed. The number of spectra classified is 233,050, covering the entire sky from the North Pole to the South.

The Spectrum of Coronium.—The new red line in the spectrum of the corona, shown by M. Carrasco to be a member of the same series as λ 5303·3, has enabled Prof. Nicholson to extend his analysis of the coronal spectrum to include the six outstanding lines, whence the conclusion is arrived at that the Coronium atom is a simple-ring system with nucleus $7e$. When it has eight electrons or a single negative charge it emits the lines $\lambda\lambda$ 6374·5, 5303·3, 4566·0, 4359·0, 3642·5, and 3534·0. The lines in the spectra of neutral or of positively charged atoms are found to be situated too far in the ultra-violet for observation (No. 5, Monthly Notices, Royal Astronomical Society).

The Visibility of Stars in Daylight.—M. Bigourdan's researches in the history of astronomy have brought to light some interesting facts concerning early modern observations of stars in daylight (*Comptes rendus*, No. 22). The earliest record appears to be a note found by Zach among the papers of J. Gaultier, stating that the latter at Aix-en-Provence observed Mercury on March 1, 1611, at 6h. 30m. a.m. —the sun would then be above the horizon. The daylight observation of stars proper appears to date from May 2, 1632, when W. Schickhard first saw Regulus.

GEOLOGY OF SOUTH-WEST AFRICA.

IT is not often that a geological memoir appears in such inspiring circumstances as that issued by the Mines Department of the Union of South Africa on "The Geology and Mineral Industry of South-west Africa" (Pretoria, 1916, price 7s. 6d.). Mr. P. A. Wagner writes with an eye for geographic features and for plant-associations, and his photographic illustrations, such as that of the Okavango River, or that of the noble barchans in the sand-desert, convey vivid information in regard to the new territory of the Union. Here and there in his admirably written text a war that has recently taken place is casually mentioned; otherwise the transference of this rich and developing mineral territory from one Government to another could only be guessed by the quiet excision of "German" from its official name. An exact Dutch translation follows the English text, and the titles beneath the pictures are given in both languages. In a few minutes we find ourselves at home with the simple phraseology of our African comrades, and the memoir will form an excellent lesson-book for mining men travelling out to "Walvis Bay."

Mr. Wagner's description of the geology, accompanied by a remarkable, if provisional, coloured map, shows how the features familiar through the Cape Province stretch beyond the Kalahari region to the coast. Certain shales in the Karroo formation appear, however, to be marine in South-west Africa, and Lower Miocene strata occur in detached areas south of Lüderitz Bay. The composite gneisses of the basal complex are finely illustrated from Diamantberg. In the author's review of the very varied mineral prospects we are glad to note that the Union Government has arranged for the protection of guano-producing birds. The output of minerals so far has been practically confined to the very prosperous diamond-fields of the Lüderitz coast, and the copper ores of the Grootfontein district in the north-east.

Mr. Wagner directs attention to the great explosion which formed the ring of Geitsi Gubib, north of Berseba (Bathsheba). This ring has been recently described by Mr. A. W. Rogers (Trans. Roy. Soc. S. Africa, vol. v., p. 247), who shows that, contrary to Dr. Schenck's opinion, volcanic rocks are not to be found in its materials. The "breccias" and tuffs are formed mainly from shattered sediments, together with some fragments of deep-seated holocrystalline rocks. The central "crater" is merely the result of denudation acting on a softer tuff within a wall of more resisting but equally fragmental matter. The whole mountain is a volcanic neck about a mile and a half in diameter, choked by its products of explosion.

G. A. J. C.

ANTARCTIC HYDROGRAPHY.

MANY of the scientific results of the *Scotia* Antarctic Expedition (1902–04) of Dr. W. S. Bruce have now appeared, but want of funds has seriously delayed the publication of the valuable observations. The Royal Society of Edinburgh, which has done a great deal to further the publication, has issued in its Transactions (vol. li., 4, pp. 71–170) a lengthy memoir on the temperatures, specific gravities, and salinities of the Weddell Sea and of the North and South Atlantic Ocean by W. S. Bruce, A. King, and D. W. Wilton. The surface observations were taken daily by Mr. Wilton from the beginning to the end of the expedition, except during the wintering of the *Scotia* at the South Orkneys, and extend from the North Atlantic to the Weddell Sea *viâ* the Falkland Islands, and home *viâ* Gough Island and Cape Town to St. Helena and the Azores. In Antarctic waters observations were generally taken every four hours, and sometimes oftener. In addition, many readings were taken at depths down to 3000 fathoms.

Dr. Bruce recounts the minute care exercised in taking the observations, which deal with nearly six hundred samples. The densities were determined by hydrometers lent by Mr. J. Y. Buchanan. Deep samples were obtained by the Buchanan-Richard water-bottle. Occasionally the Pettersson-Nansen insulated water-bottle with the direct-reading Richter thermometer was used, but for polar work this has its drawbacks, quite apart from its excessive cost and the liability of loss in bad weather. The fine screws are difficult to manipulate with cold fingers, and it is questionable whether the insulation is trustworthy at low air temperatures. In one case the contents were frozen solid when the bottle came on deck. On the other hand, the Buchanan-Richard bottle is cheap, easily manipulated, does not jam by freezing, and is trustworthy at any depths. Nor is it probable that errors are frequent or large due to variations in the point at which the mercury breaks in the reversing thermometer. In the case of every sample, in addition to the data relating to collection, those in relation to the determination of its density are given. The density is given (1) at the temperature of the experiment, (2) at 15·56° C., (3) at the temperature of the sea at the time the sample was taken. This last gives the actual density of the water *in situ*. Some of these calculations are the work of Mr. A. King, and all the others have been checked by him. Exigencies of space and expense have prevented a full discussion of the results and the addition of charts, but, nevertheless, the memoir constitutes the finest contribution ever made to Antarctic hydrography.

PORTLAND CEMENT.

PORTLAND cement has in recent years come into such extensive use for a variety of purposes that particulars concerning it should interest a wide circle of readers. In vol. lix. (part iii., January, 1916) of the Transactions of the Institution of Engineers and Shipbuilders in Scotland, appears a paper by Mr. B. J. Day on the manufacture, properties, and testing of Portland cement, with a special description of a cement works erected by the author at Aberthaw, Glamorganshire. This article forms the basis of the following short descriptive account; and by Mr. Day's courteous permission we are able to use two of the illustrations which accompany his paper.

The difference between limes and cements should be clearly understood. Common lime, made by burning pure limestone (composed essentially of calcium carbonate), slakes in water, but has no hydraulic properties (does not harden or set under water). Hydraulic lime, made by burning at a low temperature impure limestones or limestone mixed with clay, slakes on adding water, and has hydraulic properties. Portland cement is made by burning at a high temperature—to incipient fusion of the material—a definite mixture of limestone with clay or shale, and finely grinding the resulting clinker. The powder so obtained has strong hydraulic properties. It is important to distinguish Portland cement from Roman cement and certain other natural cements, and slag cements, all of which are inferior in strength and less constant in composition.

The original Portland cement, patented in 1824 by Joseph Aspdin, of Leeds, was so called because after

hardening it looked like Portland stone; but though the composition was similar to that of modern Portland cement, the mixed material was only lightly calcined. Portland cement is manufactured in England, chiefly about the Thames and Medway, Rugby, Leamington, Cambridge, Hull, and the north-east coast, and also in South Wales.

The preparation and mixing of the raw material before burning is effected by the dry process or the wet process. The method known as the semi-wet process is practically the same as the wet process, using less water.

In the dry process the raw material is stored under cover before being crushed, so that the exact amount of moisture may be ascertained and allowed for when mixing lime with the shale or clay. After preliminary crushing in gyratory or jaw-crushers, the raw materials are dried, then weighed, and delivered to the mills in definite proportions. After grinding to an extremely fine powder the mixture is fed into the kiln for burning. In the wet process the material is often delivered in the correct proportions from the quarry into crushers or wash-mills.

On the Thames and Medway, the raw material, consisting of soft chalk and river mud, is washed through fine-meshed sieves, and the "slurry" is then pumped or elevated to the kiln. At Aberthaw, the raw material, consisting of hard limestone and shale, is crushed in jaw-crushers and delivered to the wet mills for grinding with water to a fine slurry.

In the wet process less power is required to grind hard material, and the slurry is easily dealt with by means of pumps; but more fuel is needed in the kiln to burn the slurry than the dry powder in the dry process.

At the Aberthaw cement works are beds of hard crystalline limestone interstratified with beds of shale, all the necessary materials thus occurring together on the spot. The quarrying is done by means of a steam navvy, aided by a small amount of powder to shake the face of the quarry.

The crushed material is ground in vertical mills (chiefly in America), or in horizontal mills (mostly in Europe). Horizontal mills are generally installed in pairs, a ball-mill for preliminary grinding, and a tube-mill as a finishing mill. The tube-mill is much longer than the ball-mill, and contains flint pebbles of various sizes instead of steel balls. The ground material from the ball-mill passes through sieves to reach the tube-mill, the portion retained by the sieves being automatically returned to the ball-mill for further grinding. In the wet process similar mills are employed with only coarse sieves or screens, as otherwise they would tend to get choked.

FIG. 1.—Raw-mill grinding-house at Aberthaw during construction, showing arrangement of ball and tube-mills.

At Aberthaw, after leaving the mills, the slurry falls into a trough, and by means of a special conveyer is delivered to two slurry pumps, which deliver the slurry into one of two large storage tanks. The chemist takes half-hourly samples from each mill, and hourly samples from the large storage tanks while being filled. The mixture in the tanks is thus kept practically constant, and is continually agitated.

From the storage tanks the slurry is delivered to the feeding apparatus of the nearly horizontal rotary kilns. Dried, finely-powdered coal-dust is blown into the outlet end of the kiln, and ignites 8 to 10 ft. from

the outlet, the temperature in the burning zone being approximately 1370° to 1650° C. This temperature is gradually reduced until at the inlet end it is 315° to 455° C. The slurry is first dried by the hot issuing gases, then water of combination is driven off and organic matter carbonised; the dehydrated clay and lime gradually approaches the clinkering zone, where at 1540° to 1650° C. the combination of the lime, silica, and alumina takes place. The clinker thus formed continues to travel down the kiln and drops into the cooler as a white hot mass of small nodules. As these pass down the cooler the incoming air abstracts heat from the clinker, and thus receives a large part of the heat necessary for combustion. Each ton of clinker burnt requires about 5 cwt. of fuel.

Formerly the shaft or chamber kiln was used, but the rotary type of kiln is now almost universally adopted in modern plants of any size, owing to better burning of the clinker, greater output, and economy.

The clinker is finally ground to an impalpable powder, the grinding arrangements being similar to those for the raw materials. The Aberthaw works produce 2400 tons of cement per week. J. A. A.

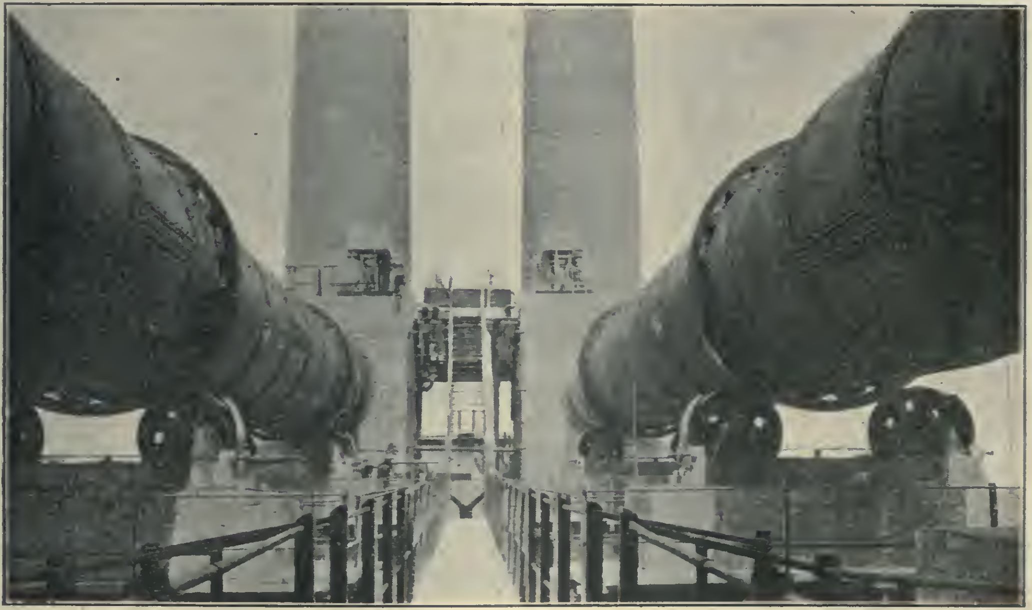

FIG. 2.—View taken from the kiln firing platform, showing the two 200-feet kilns, slurry feed apparatus, dust chambers, and chimneys at Aberthaw.

THE SOIL AND THE PLANT.

NATURE'S CYCLE AND MAN'S CONTROL.[1]

IT is a familiar observation that the upper layer of the soil alone is well adapted for plant growth, the underlying material or subsoil being wholly unsuited for the purpose. But this distinction did not always exist. When the soil was first laid down it was all like the subsoil; something, however, has happened to bring about the change. Observations on land slips and cliff falls, and direct experiments, all show that whenever subsoil is left exposed to the air it begins to cover itself with vegetation, the seeds of which are blown or carried on. The first plants that come up draw some of their food material from the soil, and they build up their leaf and stem tissues partly out of this and partly out of the carbon dioxide in the air. The process requires that energy should be put into it; in this case the energy comes from sunshine, and as neither energy nor matter is ever destroyed in natural processes they are added to the mineral matter of the soil after these plants die, and their leaves, stems, etc., become mingled with it.

Direct experiment shows that this addition of plant residues is beneficial to plant growth, and it is now known that the difference between the surface and the subsoil lies largely in the presence of residues left by generations of plants that have lived and died there. The problem is to find why the plant residues are so beneficial.

These plant residues contain carbon and oxygen in large proportions, hydrogen and nitrogen in smaller proportions, and lesser quantities of phosphorus, calcium, magnesium, potassium, etc. The chief reaction in the soil is an oxidation; oxygen is absorbed and carbon dioxide given out in approximate equal volume. The carbohydrates of the plant disappear very rapidly; some of the cellulose takes longer and gives rise to the black humus familiar to all gardeners. The nitrogen appears as nitrate. This last is not quite what one would expect. In the decomposition of protein as studied in the laboratory the result is always a mixture of amino-acids. Under the action of putrefactive bacteria the decomposition is carried a stage further, yielding ammonia and other bases, but nitrates are not found by the processes of the chemist. At first sight, therefore, the laboratory decomposition appears quite distinct from that in the soil, but close study shows that this is not so. Representatives of the groups isolated in the laboratory can be found in the soil, and, what is still more to the point, if a trace of chloroform or toluene is added to the soil no nitrate is formed, but ammonia accumulates instead. When a trace of untreated soil is added the process starts again, and nitrate is found as

[1] Summary of two lectures delivered before the Royal Institution on February 29 and March 7 by Dr. E. J. Russell.

usual. Thus it appears that ammonia is the precursor of nitrates, and is itself preceded by the usual amino-acids. The distinguishing feature of the soil decomposition is simply that it is carried several stages further.

This decomposition is absolutely indispensable to the plant; the initial products—the proteins—are useless for plant nutrition; the intermediate products are not much good; the ammonia is considerably better, while the final stage—the nitrate—is the best of all.

During this decomposition also, the energy stored up by the plant during its lifetime is run down, so that there is a transformation both of material and energy. Neither the energy nor the material is wasted; they go to support a vast population of the most varied kind, ranging from microscopic bacteria to earthworms. All these depend on the plant residues for their food and their energy. But theirs is no case of taking all and giving nothing in return. Their work is nothing less than the production of food for the plant: preparing new plant food out of old plant residues.

Thus we have a great cycle going on in the soil; dead plant residues mingle with it, and give life to countless micro-organisms, which in turn manufacture

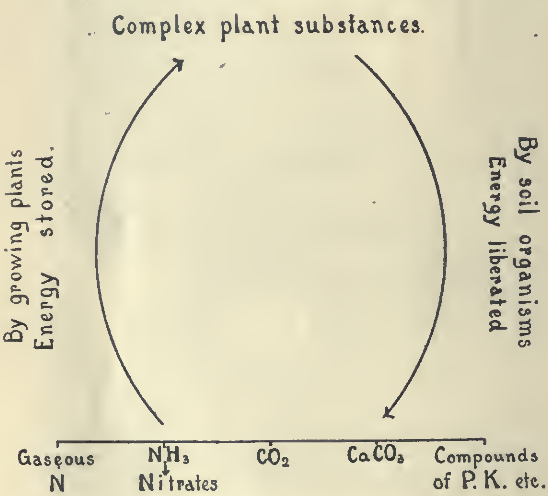

FIG. 1.

out of these residues food for a new generation of plants.

It is necessary to set some limits to the inquiry, and so we restrict ourselves to the production of nitrates. This process is the work of a great number of organisms, some of which carry out the first stages, and others the later stages. It resembles the process of making munitions in that the first stages can be brought about by a large variety of workers, while later stages are much more specialised, and can be effected only by one or two special workers. Indeed, in the wars of the eighteenth century the process was actually under the Ministry of Munitions of the time, and both in Sweden and in Germany elaborate instructions were drawn up for the working of nitrate beds.

The process of nitrate formation is not free from waste; starting with 100 parts of nitrogen as protein, one never recovers 100 parts of nitrogen as nitrate; there is always a loss. But the fault does not appear to be with the special organisms carrying out the last stages of the process, for at least 96 per cent. of the ammoniacal nitrogen reappears as nitrate. It is not clear that it lies with the organisms producing ammonia; at any rate, they can work without loss. The probability is that the loss arises from some of the nitrate that has been actually formed.

However it arises, this loss, as well as the leaching out of nitrate by rain, would in natural conditions bring the stock of soil nitrogen to a very low level if there were no counterbalancing processes, and for the last fifty years chemists and bacteriologists have been searching the soil very thoroughly to find out how these gains are brought about. Two sources are known: the organisms associated with clover and other Leguminosæ, and free-living nitrogen-fixing organisms. These differ very much in appearance and mode of life, but they both require energy for the nitrogen fixation, and this they obtain from the combustion of carbohydrate materials.

It must not be supposed, however, that the organisms bringing about these changes are the only ones in the soil, or that they lead their lives quite independently of the rest of the soil population. Indeed, they could scarcely do so in any case, for there is only a limited store of food and energy, and whatever is not helping is hindering them. Numerous experiments show that there is some factor—neither food, air, water, nor temperature—which is operating to keep down their numbers. As it is put out of action by heating to 55° C., or by traces of volatile antiseptics, and can be reintroduced by adding a little untreated soil, it is presumably biological, and the evidence shows that it consists in part at least of certain amœbæ; it is quite possible that other forms are involved as well. But whatever the detrimental organisms may be they impede the work of the organisms producing plant food in the soil. Fortunately they are put out of action more easily, so that we get the apparent paradox that any process fatal to life (but not too fatal) proves ultimately beneficial to fertility, while any process beneficial to life proves ultimately harmful. Long frost, drought, heat, therefore benefit the useful makers of plant food, while prolonged warmth, moisture, and treatment with organic manures lead to deterioration or to "sickness," as the practical man puts it.

Having thus set out the general nature of the cycle, we next proceed to see how and to what extent it can be controlled.

Control may take place in two directions: the amount of organic matter, *i.e.* raw material out of which plant food is made, may be increased, or the pace of the manufacturing process may be forced.

The necessity for increasing the organic matter in the soil was realised very early. Arable farmers soon found that land cannot be cropped indefinitely; sooner or later it becomes "exhausted"; it recovers, however, if it is left to itself for a time, so that natural vegetation can spring up and die again. The Mosaic law commanded the Jews to leave their land for one year in seven and not to reap "that which groweth of its own accord." The system survived in our own land through Saxon and medieval times; land was uncropped one year in three, two corn crops were taken, then grass was allowed to grow up on the stubble to be ploughed in. The principle still underlies our modern rotations; crops are grown, then the land is left covered with vegetation, but the process is regulated by sowing a definite mixture of grass or clover chosen to make vigorous growth.

Another method for increasing the amount of organic matter in the soil consists in growing a crop exclusively for the purpose of ploughing it in. This also goes back to ancient times: Theophrastus, 300 years before Christ, tells us that beans were grown in Macedonia and Thessaly expressly to be ploughed in at flowering time, and Varro, about 50 B.C., states that lupins were grown for the same purpose. This method

is called "green manuring," and even to-day is not so fully developed as it ought to be. Instead of ploughing in the crop it may be fed to animals on the ground; there are other methods also, but the object is always the same.

The cultivator's aim, however, is not to accumulate fertility but to use it. We must therefore turn to the other part of the cycle and see how far the down grade can be controlled. The most obvious method is to try to control the soil organisms. This has proved very difficult, and only the fringe has yet been touched. Soon after bacteriologists had picked out the organisms that cause clover to fix nitrogen they conceived the idea of breeding them in quantity and putting them on to the seed or into the soil, with a view of getting better clover crops, and therefore a greater store of fertility. These hopes were disappointed. Inoculation succeeded only in one case; when a new leguminous crop was introduced it sometimes proved more economical to add the proper strain of organisms than to wait until the native organisms had had time to adapt themselves. This has happened in Scotland, Canada, and the United States. But usually in this country the proper bacteria appear already to be present, and little is gained by adding to their numbers; they merely die down to the proper number the soil can carry. If one wishes to increase the number it is necessary to improve the soil conditions. Even this does not settle the matter, for, as already shown, the soil population is very mixed, and improvements in soil conditions may benefit the whole crowd, bad and good. Indeed, under specially intense glasshouse conditions the harmful population may prosper so much that the efficiency of the soil becomes lowered and the soil becomes "sick." The remedy is obvious: it consists in improving the soil population, and this is done by taking advantage of the fact that the harmful organisms are more easily killed than the useful ones. Steam is used successfully in glasshouses; antiseptics would be cheaper, but in spite of considerable search, nothing has yet been found suitable for field work. The problem is still under investigation.

More success has been attained in the control of soil conditions. Fortunately these are the same for organisms as for plants, so that anything benefiting the one helps the other as well. But there is one fundamental law that always holds; the plant must have all its requirements satisfied or it will fail; for example, no amount of food or water makes up for the lack of temperature. Anything setting a limit to growth is called a limiting factor. Common limiting factors in the soil are sourness, wetness, dryness, poverty, thinness of soil, etc. In soil fertility problems the first step is always to discover the limiting factor, and then to put it out of action.

One of the commonest defects is sourness or lack of lime. From the dawn of history this has been one of the troubles of the Celtic tribes, and before history began they had discovered the remedy. Pliny tells us that they drew chalk out of the earth to "nourish" the soil; to this day the process is still carried out in Hertfordshire much as he describes it. In modern times ground lime is more convenient, and ground limestone sometimes proves even better still.

Wetness can be remedied only in one way—by drainage. This is an old art that was forgotten for a long time; it is not mentioned in the great English agricultural revival of the sixteenth century. Gervase Markham, for instance, wrote books on every branch of farming—so many, indeed, that his publishers made a contract with him to write no more—but never one on drainage. By the middle of the seventeenth century it was well known, though not much practised; by the middle of the nineteenth century, however, it was extensively carried out. Much of it wants redoing. Pipe drainage is out of the question nowadays on any large area, but a cheap and effective substitute seems to be forthcoming in mole drainage, which consists in making tunnels through the soil about 9 to 18 in. below the surface with a special form of plough.

Dryness can either be overcome by adding water, as in the big irrigation schemes, or by taking more care of the natural water supply. Addition of clay or organic matter reduces the loss of water; so also does the preservation of a fine soil mulch on the surface. Implements have been devised to produce this soil layer. Much can be done also by selecting suitable crops or varieties; special drought-resisting wheats have been bred in Australia, and maize in the western States of America.

Shallowness of soil is, however, more serious, especially when the thin soil is underlain by gravel or very coarse sand; indeed, in this case no one has evolved any satisfactory method of treatment. Something may be done if a soft rock lies beneath, and especially if it forms only a thin layer which can be removed. But when all is said and done, there remain great areas of waste land that cannot be dealt with on our present methods.

Apart from these cases, however, a very considerable degree of control of the soil cycle is possible. The question naturally arises: How far can the process go? Not indefinitely. In any scheme of improvement we are soon brought up against the fundamental law that plants must have all their requirements fulfilled, anything lacking setting a limit to their growth. Agricultural investigators aspire to a good deal in the way of control and improvement, but they admit they cannot overcome the weather. Here, then, is one limiting factor which has wrecked many schemes of soil improvement.

Another is the soil type. In spite of all efforts a clay remains a clay and a sand remains a sand. A gardener on sandy soil may with great pains be able to grow clay-soil plants, but they will never "do" as well as if equal care were bestowed on them in their natural habitat. The farmer cannot lavish care on individual plants, but has to deal with masses; he therefore is less able to overcome the difficulties of soil type. This problem, however, is not insuperable, and attempts are now being made to deal with it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies has published a report to the Senate on the desirability of instituting degrees, other than the doctorate, to be given for original research; the board is of opinion that the present is a favourable opportunity for instituting a more distinctive recognition of research work than is at present available. Two classes of student have to be considered: first, that composed of graduates of the University; and, secondly, that consisting of graduates of other universities who may, under the present regulations, obtain the Cambridge degree by two years' research work carried out in the University. The Board recommends that the degrees of Bachelor of Letters and Bachelor of Science be established; that a Bachelor of Arts of the University may, in or after his eleventh term, submit for approval a dissertation upon original research for the degree of Bachelor of Letters or Science; that a research student who is not a graduate of the University may submit a dissertation upon original research for one or other of the new degrees after six terms' residence. It is also recommended by the board, although with dissentients, that holders of the new degrees may pro-

ceed to the degree of Master of Arts in the same manner as do Bachelors of Arts at present.

Dr. Cobbett and Dr. Graham-Smith have been re-appointed University lecturers in pathology and hygiene respectively.

The Conference (1916) of the Association of Teachers in Technical Institutions will be held on Saturday, June 17, at 2.30 p.m., in the Lecture Theatre, Day Training College, Southampton Row, W.C. The chair will be taken by the president, Dr. T. Slater Price (military duties permitting), and Dr. W. Garnett will deliver an address. A number of important resolutions referring to technical education, scientific research, and industrial development will be put to the meeting.

Arrangements have been made, with the approval of the Foreign Office, for extending to British prisoners of war interned abroad the benefits of the scheme, which has been in operation for the last year in connection with Ruhleben, for supplying selected books of an educational character to those of the interned who may be desirous of continuing their studies in any subject. Under this scheme several thousands of carefully selected volumes, mostly standard works, have been supplied to the Ruhleben Camp, which is now provided with excellent libraries (class, reference, and lending). These books, which have been sent out through the agency of officers of the Board of Education, have proved a great boon to the interned, and have enabled sustained educational work of a definite character to be carried on by the Camp Education Department formed among the prisoners. In view of the value of the work the Board of Trade (Marine Department) have decided to take it into account in connection with their examinations for the certificates of competency granted by them to officers of the Mercantile Marine and the Fishing Service. Accordingly, arrangements have now been completed for recording the time spent by any prisoner interned at Ruhleben or Groningen in the study of nautical or other subjects. An appeal is, therefore, now made for a plentiful supply of new or second-hand books of an educational character (light literature and fiction are available from other sources) to meet the needs of the many thousands of British prisoners interned in enemy or neutral countries. It is to be hoped that to this appeal there may be a liberal response. A circular explanatory of the educational book scheme can be obtained by sending a postcard addressed at the Board of Education, Whitehall, S.W., to Mr. A. T. Davies, who is in charge of the arrangements.

Science for May 5 contains an interesting and suggestive address by Prof. Alex. Smith on "The Training of Chemists," in which the questions of standard and overlapping courses, lecturing, and laboratory facilities are dealt with. Prof. Smith deprecates the very general practice of compelling undergraduates who have studied chemistry at school to take the same course in their first year as those who know nothing of the science. He advocates placing such students in a section by themselves, and finds in his experience that they progress 50 per cent. more rapidly when so segregated. The overlapping which results from the instructor in one branch of chemistry (*e.g.* qualitative analysis) assuming that the student is ignorant of facts and principles which he has already learnt in another branch (*e.g.* the inorganic course) is also emphasised. It is pointed out that, on the other hand, organic chemistry frequently suffers from the fault of being taught as a separate science and not sufficiently co-ordinated with the inorganic branch. Prof. Smith urges that considerable advantage would accrue by the standardisation of the courses in the various branches of chemistry for the different universities and colleges, on account of the facts that migration from one college to another is rapidly increasing, and that colleges of medicine are requiring previous college work. In order that students may acquire that ability to apply theoretical conceptions which will, more than ever, be indispensable in the future, standardising the elementary courses in chemistry is essential. Doubt is thrown on the value of lecturing to elementary students. It is argued that lectures inculcate an ability to understand statements made by others, whereas the object to be achieved is to train the student to make correct statements on chemical topics, and deduce sound conclusions, *himself*, even though these conclusions are not new. Prof. Smith advocates book study of the subject, the class work being restricted to the testing of the work prepared, experiments illustrating the work, the discussion of difficulties, and the asking of questions. He admits the value of lectures to students who know how to study; that is, to those taking the more advanced courses.

SOCIETIES AND ACADEMIES.

London.

Royal Microscopical Society, May 17.—Mr. E. Heron-Allen, president, in the chair.—J. W. **Purkiss**: Some suggestions regarding visual efficiency in the use of the microscope and other optical instruments. From experience of work with the spectrophotometer and other comparative instruments for measuring colour absorptions, the author had arrived at the conclusion that the observer's visual efficiency and accuracy over prolonged periods depend very largely on adjusting the light in which he was working, so that it should be approximate to the light-intensity in the field of the observing instrument. He developed this principle in its application to the microscope and other optical instruments, and showed how the more or less rapid succession of efforts of the eye to accommodate itself to changes of luminosity was usually a much more potent cause of eye fatigue or strain than the actual conditions of light in the field of the instrument itself.—Rev. H. **Friend**: Alien Oligochæts in England.—A. T. **Watson**: A case of apparent intelligence exhibited by a marine tube-bearing worm, *Terebella conchilega*.

Physical Society, May 26.—Prof. C. V. Boys, president, in the chair.—T. **Smith**: The correction of chromatic aberrations when the external media are dispersive. When one of the external media of a lens system is dispersive it is not possible to ensure the absence of differences in the size and position of images of all objects formed by length of different wave-lengths. The degree to which correction can be carried is investigated, and formulæ are given by which the power and position of the external surfaces of a system can be found when the type of correction to be adopted is given.—J. **Guild**: Note on the use of the autocollimating telescope in the measurement of angles. The measurement of angles by means of the autocollimator resolves itself into the measurement of the distance between two images produced in the focal plane of a micrometer eyepiece. In most cases the light forming these images passes through portions of the object glass on opposite sides of a diameter. It is shown that, when this diameter is perpendicular to the direction of the displacement to be measured, uncertainty and error are introduced on account of any residual spherical aberration of the object glass and the depth of focus of the telescope. One or two particular cases are discussed in which it is shown how this may be obviated.—E. **Hatschek**: The viscosity of

colloidal solutions. The author, in reply to some remarks made by Mr. W. B. Hardy in the course of his Guthrie lecture, points out (*a*) that no viscosity formula can cover the stage of gel formation, since the change from a liquid with only slight anomalies to a system having many properties of an elastic solid necessarily precludes this, and (*b*) that the formula given by Einstein, and, independently by himself, for the viscosity of a suspension of rigid spherical particles, does not in any event apply to systems such as discussed by Mr. Hardy, which belong to the class known as emulsoids.

Linnean Society, June 1.—Sir David Prain, president, in the chair.—C. **Reid** and J. **Groves**: New types of fossil Characeæ from the Purbeck Beds. The earliest known remains of undoubted Characeæ were detached fruits recorded from the Lias and Oolite, the earliest remains of the vegetative parts being those in the Middle Purbeck Beds. By subjecting slices of the limestone, in which the plants were found, to a prolonged drip of very slightly acidulated water, so that the Chara-remains were etched out, the authors had been able to elicit much fresh information as to structure, which had not been obtainable from the sections and polished surfaces of chert —Prof. G. E. **Nicholls**: The structure of the vertebral column in the *Anura phaneroglossa* and its importance as a basis of classification.—Prof. J. **MacLeod**: Quantitative variation in certain diagnostic characters of ten species of the genus Mnium. Is it possible to describe and to identify an animal or a vegetable species by means of numbers representing the value of the specific characters? The author has tried to realise this by measuring thirty-eight characters in about ninety species and twenty varieties of the genus Carabus. The war prevented him from finishing and publishing his work. He tried to carry out similar work with plants, taking mosses of the genus Mnium. He limited himself to the study of the leaves of the fertile stem of ten species of that genus. When the length of the successive leaves from the base to the summit of a fertile stem of a Mnium is measured it is seen that the length increases up to a maximum and then diminishes. This curve represents the variation of the character under consideration along the axis. This peculiar form of variation may be called gradation. The gradation of the measured characters of the ten species of Mnium shows much diversity. In these examples it is possible to find the name by four characters; but it may be necessary to use five or more characters. As a dozen characters are available, it is hoped that the identification of a given specimen will be always possible, even if the species were more numerous.—W. L. **Distant**: The Rhyncota from the Indian Ocean.

Dublin.

Royal Irish Academy, May 22.—The Most Rev. Dr. Bernard, Archbishop of Dublin, president, in the chair. —J. **Algar**: Diketones derived from diacetoresorcinoldimethylether. The diketone dianisoylacetoresorcinoldimethylether is obtained by the condensation of diacetoresorcinoldimethylether with anisic ester by means of sodium. Similar diketones may be obtained by the condensation of the dimethylether with the esters of phenylacetic, acetic, and oxalic acids. Diacetylacetoresorcinoldimethylether and di-α-phenylacetylacetoresorcinoldimethylether are colourless crystalline substances, while dianisoylacetoresorcinoldimethylether is coloured slightly yellow, and dimethoxy*iso*phthaloyldipyruvic, ethylester is coloured strongly yellow. These diketones on heating with concentrated hydriodic acid should give dichromone or diflavone derivatives. In the condensations with anisic and phenylacetic esters the yields of the diketones were insufficient to try this reaction. Diacetylacetoresorcinoldimethylether on heating with hydriodic acid gave a tarry product, from which an extremely small amount of colourless substance was isolated, which dissolved in concentrated sulphuric acid, giving a solution with the strong green fluorescence characteristic of chromone derivaties. This colourless substance was probably a dichromone derivative.

Paris.

Academy of Sciences, May 29.—M. Camille Jordan in the chair.—The President gave an account of the scientific work of the late General J. S. Gallieni, correspondant in the section of geography and navigation.—G. **Bigourdan**: Joseph Gaultier and the discovery of the visibility of the stars in full daylight. This discovery has been in turn attributed to Picard (1668), Morin (1635), Hortensius (1633), Schickhardt (1632). It is shown that this discovery was made in 1611 by Joseph Gaultier, of Aix-en-Provence (see p. 328).—P. **Duhem**: The general theory of electric oscillations.—M. **Balland**: An unpublished letter of Parmentier. The letter is dated August 13, 1800, and has reference to the quality of the bread supplied to the Hôtel des Invalides.—B. **Globa-Mikhailenco**: The movement of a billiard ball with sliding and rolling friction.—M. **Mesnager**: All points of a supported thin rectangular plate are lowered on the application of a uniform load, no element remains horizontal, the lines of greatest fall all end at the centre.—C. **Störmer**: The integration of a system of differential equations met with in the study of a cosmical problem. The equations occur in the problem of finding the motion of an electrified corpuscle in the field of an elementary magnet, supposing the corpuscle to be also submitted to the action of a central force emanating from the magnet and inversely proportional to the square of the distance.—Ed. **Sarasin** and Th. **Tommasina**: The proof of a third Volta effect and the experimental confirmation of the given explanation.—F. **Zambonini**: The relations which exist between the angles of mixed crystals and those of their components. The mixed crystals studied included the molybdates of lead and cerium, calcium and cerium, strontium and cerium, lead and didymium, calcium and didymium, calcium-yttrium-cerium, and the tungstates of calcium and cerium. In nearly all the cases studied there was no precise relation between the values of the angles and the composition.—P. **Fallot**: The presence of the Aptian in the sierra of Majorca.—C. **Sauvageau**: The heterogamic sexuality of *Alaria esculenta*.—J. **Amar**: The functional value of the mutilated limbs.—Ch. J. **Gravier**: The Actinean fauna of the island of San Thomé (Gulf of Guinea).—A. **Trillat** and M. **Fouassier**: Study of some factors exercising an influence on the rapidity of evolution of the typhoid bacillus in milk.

Cape Town.

Royal Society of South Africa, April 19.—Dr. L. Péringuey, president, in the chair.—Sir T. **Muir**: Note on pfaffians connected with the difference-product. In addition to the discovery of the connection referred to in the title, there is established a series of theorems bringing pfaffians into relation with permanents and other integral functions.—Sir T. **Muir**: Note on the so-called Vahlen relations between the minors of a matrix. The paper contains a critical examination of the relations in question, and an attempt to put the subject on a sounder basis. There is also incidentally involved a rectification of the statements hitherto accepted regarding the history of the subject.—R. T. A. **Innes**: The development of the perturbative function in the theory of planetary motion. The author has

published a paper in the society's Transactions, 1911, upon the Newcomb operators used in the algebraical development of the elliptic perturbative function. The present paper deals with a further extension of the uses of these Newcomb operators.—P. A. **Wagner**: A contribution to our knowledge of the "national game" of Africa. Among most of the native races of Africa there is played in one form or another, either in rows of holes scooped out of the ground or on wood, stone, or even ivory boards, a peculiar game of skill, that from its wide distribution over the continent has been appropriately styled "the national game of Africa." The game is described by the author, and is essentially a war game. Two players or sides direct a contest between armies of equal strength, the object in view being the capture or "killing" of "men" who are represented by small stones, seeds, shells, or fragments of dry cow-dung.—J. **Hewitt**: A survey of the Scorpion fauna of South Africa. The main features of the Scorpion fauna of South Africa have been known for some years, though up to the present time no complete lists or descriptions of the fauna as a whole have been available. In this paper an attempt has been made to provide a trustworthy synopsis of the main distinguishing characters of all the species and varieties known to inhabit South Africa.—S. **Schönland**: Note on a petiole and portion of the lamina of *Cotyledon orbiculata* functioning as a stem. The author describes a case of the formation of adventitious roots on a leaf of *Cotyledon orbiculata*, which remained attached to its stem for seven months afterwards. The roots grew considerably, the petiole and the lower part of the leaf thickening and resembling the stem in outward appearance. So far as examined, the petiole retained the external structure characteristic of such an organ, and did not turn into a stem as was expected, although it had to perform stem-functions for such a long time. In analogous cases in other plants radical changes have been observed.

BOOKS RECEIVED.

Harper's Hydraulic Tables for the Flow of Water, in Circular Pipes under Pressure, Timber Flumes, Open Channels, and Egg-shaped Conduits, with much Accessory Information. By J. H. Harper. Pp. 192. (London: Constable and Co., Ltd.) 8*s.* 6*d.* net.

The Principles of Apprentice Training, with Special Reference to the Engineering Industry. By A. P. M. Fleming and J. P. Pearce. Pp. xiii+202. (London: Longmans and Co.) 3*s.* 6*d.* net.

Chemistry in the Service of Man. By Prof. A. Findlay. Pp. xiv+255. (London: Longmans and Co.) 5*s.* net.

Revista de la Academia de Ciencias Exactas. Fisico-Quimicas y Naturales de Zaragoza. Tomo i. Numero i. Pp. 72; Academia de Ciencias Exactas. Fisico-Quimicas y Naturales de Zaragoza. Discurso leido por su presidente, Dr. Z. G. de Galdeano, en la sesion inaugural celebrada el dia 28 de Mayo de 1916. Pp. 32. (Zaragoza: G. Casanal Coso.)

Coal-Tar and Ammonia. By Prof. G. Lunge. Fifth and enlarged edition. Part i., Coal-Tar. Pp. xxix+527. Part ii., Coal-Tar. Pp. xi+531 to 1037. Part iii., Ammonia. Pp. xvi+1041 to 1658. (London: Gurney and Jackson.) The three parts, 3*l.* 3*s.* net.

Wisconsin Geological and Natural History Survey. Bulletin No. xxxvi. Education Series. No. 4: The Physical Geography of Wisconsin. By Dr. L. Martin. Pp. xxii+549. (Madison, Wis.)

The Science of Musical Sounds. By Prof. D. C. Miller. Pp. viii+286. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

Anthropological Report on Sierra Leone. By N. W. Thomas. Part i. Law and Custom of the Timne and other Tribes. Pp. 196. Part ii. Timne-English Dictionary. Pp. 139. Part iii. Timne Grammar and Stories. Pp. xxx+86. (London: Harrison and Sons.)

Specimens of Languages from Sierra Leone. By N. W. Thomas. Pp. 62. (London: Harrison and Sons.)

DIARY OF SOCIETIES.

MONDAY, JUNE 19.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Gold Coast: Some Considerations of its Structure, People, and Natural History: A. E. Kitson.

TUESDAY, JUNE 20.

ROYAL STATISTICAL SOCIETY, at 5.15.—Annual General Meeting.

MINERALOGICAL SOCIETY, at 5.30.—The Relations of Equivalent Twinning Operations: Dr. J. W. Evans.—(1) The Meteorites of Khairpur and Soko-Banja; (2) The Classification of Meteorites: Dr. G. T. Prior.—Note on a New Occurrence of Gold from Cornwall: Lieut. A. Russell.—Volcanic Rocks from Angola: A. Holmes (with analyses by Dr. H. F. Harwood).—A New Zinc Phosphate from British Columbia: Prof. T. L. Walker.

WEDNESDAY, JUNE 21.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Report on the Phenological Observations for 1915: J. E. Clark and H. B. Adames.—Audibility of the Gun Firing in Flanders over the South-east of England, September, 1914—April, 1916: Miller Christy and W. Marriott.—The Relation between Atmospheric Pressure and Rainfall at a Single Station: Lieut. E. H. Chapman.

THURSDAY, JUNE 22.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: Evolution and Symmetry in the Order of the Sea-pens: Prof. S. J. Hickson.

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THURSDAY, JUNE 22, 1916.

LETTERS AND REMINISCENCES OF ALFRED RUSSEL WALLACE.

Alfred Russel Wallace: Letters and Reminiscences. By James Marchant. In two vols. Vol. i., pp. xi+320; vol. ii., pp. vi+292. (London: Cassell and Co., Ltd., 1916.) Price 25s. net.

ALTHOUGH Alfred Russel Wallace published a detailed autobiography, a welcome must be given to this book of letters and reminiscences, which contains fresh and interesting information regarding one of whom we wish to know all that is significant. Mr. Marchant, whose work has been a labour of love and veneration, tells us that the original idea was to make a comparative study entitled "Darwin and Wallace," which was also to include an estimate of the present-day position of the theory of natural selection. In this rather difficult task the veteran naturalist, whose courage never wavered, proposed to co-operate, but he died soon after the agreement with the publishers had been signed. Thus the originally projected book remains unwritten, and what Mr. Marchant has done is rather less ambitious. He has made a selection from several thousands of letters, and has bound these together with a sympathetic and well-written biographical commentary. We wish, indeed, that there had been more commentary and fewer letters, for some of these seem to us quite trivial, and others lose in effect because their significance is not adequately indicated. We recognise the value of having "the complete extant correspondence between Wallace and Darwin" (1857–1881), though many of the fascinating documents have been published before; but we cannot repress our judgment that the book would have been twice as valuable if half of it had been left out. It is the old story of the overcrowded picture gallery.

Restrained as Mr. Marchant is in his appreciation of Wallace, for whom he evidently has a reverence as deep as his affection, he gives us glimpses of a well-considered and intellectually balanced hero-worship which everyone will commend. But we are not at all inclined to agree that "up to the present time the unique work and position of Wallace have not been fully disclosed owing to his great modesty and to the fact that he outlived all his contemporaries." The fact is that the merits of Wallace's work have been carefully appreciated by those interested in the personal and historical side of biological progress: moreover, the charm of his personality and the sincerity of his character led both his contemporaries and those who have entered into his labours to a wise and generous inattention to various intellectual idiosyncrasies which would otherwise have blemished the great naturalist's scientific reputation. It remains, unfortunately, a matter of opinion whether Wallace was right in his vigorous dissent from Darwin's theory of sexual selection, but no biologist questions the value of his criticism and of his suggestions; on the other hand, it will be found difficult to maintain that what Wallace said (in his later years) regarding either mutations or Mendelian inheritance was marked by competence, not to speak of wisdom.

It is indicative of the greatness of the man that (as the preface tells us) there was not in all the thousands of letters—published or unpublished—anything that an editor might be inclined to suppress, but our point is that in the volumes before us it is not difficult to find examples of *obiter dicta* which are all very well in a letter, but do not, when read in cold blood, conform with what we know of the writer's sagacity. In illustration we may point to the sentence, "The Piltdown skull does not prove much, if anything," and to the remarks on Bergson and on Bateson. Little things of this sort do not, of course, affect Wallace's scientific reputation, which it would be an impertinence to speak or think of except in terms of the highest respect, but we see little use in seriously chronicling remarks which were based on misunderstanding.

But too much must not be made of the inclusion of material which a more critical editor might have sifted out, for the task of selection must have been exceedingly difficult, and there is no doubt as to the value of even minute details in producing a picturesque impression. It may well be that some of the letters that appear to us without significance will be appreciated by other readers. In any case, we have to thank Mr. Marchant for a picture of Wallace as a man which is firmer and more complete than that previously available. A very lovable and noble picture forms round our memories of him as the appreciation before us recalls his guilelessness, sincerity, kindness, and humility, his eagerness of mind and unlimited range of interests, his adventurous speculativeness, his enjoyment of all aspects of Nature, his continual thought for the welfare of his fellows, and his undimmed vision of the unseen. From first to last we get an impression of magnanimity that makes us proud of our race. As Mr. Marchant well says:—

"Apart altogether from his scientific position and attainments, which set him on high, he was a noble example of brave, resolute, and hopeful endeavour, maintained without faltering to the end of a long life. And this is not the least valuable part of his legacy to the race."

In spite of the general criticism which we have been compelled to make, we heartily congratulate Mr. Marchant on the effectiveness of his tribute to his illustrious friend. The commentary is interesting in style and admirable in its mood; the editing has been done with scrupulous carefulness. The lists of Wallace's works include his letters and reviews in NATURE, arranged chronologically. The illustrations are of great interest, especially the frontispieces to the two volumes and the charming photograph of Wallace's mother.

S

INTERNAL SECRETIONS.

The Endocrine Organs: An Introduction to the Study of Internal Secretion. By Sir E. A. Schäfer. Pp. ix+156. (London: Longmans, Green and Co., 1916.) Price 10*s.* 6*d.* net.

THE matter in this book represents the substance of the Lane Medical Lectures, given at the Stanford University, California, in 1913. It deals with a subject which is of increasing interest and importance to a large number of readers, and in which Sir Edward Schäfer has himself done pioneer work.

The object of the volume is "to supply a concise account of our present knowledge of the subject for the benefit of students and practitioners who may be desirous of obtaining more information regarding the internal secretions than is afforded by the ordinary text-books of physiology, but have not the time or opportunity to peruse extensive monographs or consult original articles."

The work is very well got up; there are 104 illustrations, which for the most part are carefully chosen and splendidly reproduced. The space which these demand probably necessitates a large page, which is the only technical fault to be found with the production of the book.

There is rather much new terminology for a volume of the size and scope of the present one. The author proposes, for the internal secretions, the general term *autacoids* (αὐτός, self, and ἄκος, a medicinal agent), and he divides the autacoids into *hormonic* and *chalonic* autacoids, according as their action is to be regarded as excitatory or depressant. According to this classification, an autacoid is to be called a hormone only if its action is an excitatory one. The idea is doubtless a good one in many respects, but the author is not unaware of the shortcomings of such a classification, and anticipates some of these on page 7 in considering the action of adrenalin in causing excitation in some structures and inhibition in others, by regarding both phenomena as being due to sympathetic stimulation; the adrenalin thus acts as a hormone in both cases, stimulating on the one hand an excitatory mechanism, on the other an inhibitory one. It is not clear why all the so-called chalones might not be regarded in like manner, at all events provisionally, since the evidence for the existence of some at least of them is by no means strong.

Names are also suggested for hypothetical autacoids, *e.g.*, parathyrine from the parathyroids, and insuline from the islet tissue of the pancreas, but these names are, of course, only of a provisional nature.

The best chapters are those dealing with the thyro-parathyroid group and those which treat of the pituitary body and suprarenal. The clinical material introduced is of especial interest.

There is a misprint of importance on page 58, where, in dealing with the synthesis of adrenalin, the words "methyl-acetyl-pyrocatechin" should read "methylamino-acetyl-pyrocatechin."

Investigations connected with the internal secretions are beset with innumerable pitfalls, and it is easy for the zealous to discover what they seek, unless great care is taken not to read too much into the results obtained. The caution required in drawing conclusions is exemplified in the case of the hormones causing "secretion" of milk: such bodies appear to be present, not only in the blood of non-lactating animals (p. 95), but also in the pituitary of the skate (p. 99), which also acts on the uterus, yet does not influence the blood pressure or the kidney.

One feature of the book should make it welcome to a general reader, namely, the reduction of references and conflicting statements to a minimum. In the chapters dealing with the interrelations of the various organs this impression cannot in any case very well be avoided, as extreme conclusions have been pushed by many workers, and conflicting statements are too often the only ones available.

There is no doubt that the book will appeal to a wide circle of readers.

SIR GEORGE DARWIN'S LECTURES.

Scientific Papers by Sir G. H. Darwin. Vol. V. *Supplementary Volume containing Biographical Memoirs by Sir Francis Darwin and Prof. E. W. Brown, Lectures on Hill's Lunar Theory, etc.* Edited by F. J. M. Stratton and J. Jackson. Pp. lv+81. (Cambridge: At the University Press, 1916.) Price 6*s.* net.

THE previous four volumes contain all the papers that Sir George Darwin desired to see reprinted; and, although there remain many scientific reports on geodesy and the tides, the editors of this supplementary volume have adhered to his judgment in excluding them. The chief occasion for adding a fifth volume is in order that Darwin's course of lectures on Hill's lunar theory may be included. These lectures were delivered to his classes of students at Cambridge, and naturally do not contain original contributions to science; indeed, Darwin in his scientific investigations scarcely touched on this subject. But it was through this course that several well-known astronomers were first introduced to Hill's work, who have since greatly developed on these lines our knowledge of the moon's motion. The lectures will now be read by a wider circle, and they thoroughly deserve to be well known. A very clear presentation of the principles of the method is given, and the more tedious analytical development is cut short where necessary with excellent judgment. This volume contains also Darwin's last paper on periodic orbits, published in 1912, too late for inclusion with his other papers on the subject.

The reader will turn with the greatest pleasure to the two biographical memoirs by Sir Francis Darwin and Prof. E. W. Brown. The former gives a vivid personal sketch of his brother. The story of the early life at Down is of interest not only on account of George Darwin, but for the incidental references to his illustrious father.

We read that Darwin's capacity as a mathematician was probably of slow growth; as an undergraduate he did not display any of that colossal power of work and taking infinite trouble which characterised him later. It surprised his friends afterwards that he should have developed the patience for making the laborious numerical calculations on which much of his most original work was based.

Prof. Brown's memoir deals with Darwin's scientific work. A leading characteristic is that he was an applied mathematician in the strict and older sense of the word. He did not undertake investigations for the interest of the mathematical processes, but for the interest of the phenomena. "Darwin belonged essentially to the school which studies the phenomena by the most convenient mathematical methods. Strict logic in the modern sense is not applied nor is it necessary, being replaced in most cases by intuition which guides the investigator through the dangerous places." When the problem seemed intractable to analysis, he had recourse to numerical methods, and never seemed to hesitate to embark on the most laborious computations which might throw light on the phenomena. In his address to the International Congress of Mathematicians at Cambridge (which is also reprinted in this volume) he referred to his methods in the words: "My own work on the subject cannot be said to involve any such skill at all, unless indeed you describe as skill the procedure of a housebreaker who blows in a safe door with dynamite instead of picking the lock."

Prof. Brown gives an admirable review of the ground covered by the papers in the earlier volumes, showing the unity of aim throughout all Darwin's work; his memoir will form an excellent introduction for those who wish to enter on a serious study of the papers.

OUR BOOKSHELF.

Diseases of Poultry: their Etiology, Diagnosis, Treatment, and Prevention. By Raymond Pearl, Frank M. Surface, and Maynie R. Curtis. Pp. xi+342. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.

This interesting and well-illustrated book contains twenty-one chapters and a glossary of technical terms. The chief subjects dealt with are the diagnosis of diseases in poultry, avian *materia medica*, a discussion of the diseases generally found to infect the various organs, poisons, internal and external parasites, tumours, and poultry surgery.

The book is stated to be a compilation, but it is unfortunate that few other than American publications appear to have been used as sources of information. Thus, the use of catechu for white diarrhœa is ascribed to Salmon, who published in 1913, while the treatment was originally set forth by Fantham and employed in England in 1910.

Mention should be made of the very clear and concise exposition of poultry hygiene that is given in the second chapter. Were the instructions detailed therein to be carried out universally there is no doubt that nine-tenths of the losses now experienced among poultry would be saved. The short account on *materia medica* for the poultryman is simple, sound, and eminently practical. Many useful hints on the administration of drugs used in combating such parasitic infections as tapeworms are also given.

The chapter on the recognition of external parasites and the eradication of diseases, such as scaly leg and depluming scabies, is ably written, and the section on skin diseases and their cure is adequately treated. When dealing with diseases of the reproductive organs an interesting account of the various abnormalities observed in eggs, their causation and prevention, is given, attention being directed to the abnormalities of practical importance in egg-production and marketing. There is also a chapter on white diarrhœa, in which the chief American views on the various forms of this disease, coccidial and bacillary, are set forth.

We have pleasure in recommending the book to the attention of the practical poultry-keeper.

F.

A Generation of Religious Progress. Edited by G. Spiller. (Issued in Commemoration of the 21st Anniversary of the Union of Ethical Societies.) Pp. 151. (London: Watts and Co., 1916.) Price 1*s*. net.

A collection of articles by nine contributors. Sir H. H. Johnston, dealing with science and religion, eloquently sketches the progress of thought from simian times, and has interesting things to say about family affection in apes and savages, and about development of ancestors into local deities. He thinks that "religion, as the conception of a heavenly being, or heavenly beings . . . concerning themselves greatly with the affairs of man, has been abolished [or, later, "put entirely in the background"] for all thoughtful and educated people by the discoveries of science"; but he shows reverence for the teaching of Jesus, and believes true Christianity is primarily concerned with the service of man.

In the remaining essays in the volume Mr. Alfred Martin describes the history and methods of the higher criticism; Mr. William Archer writes on religion and democracy, with Asia and Europe as the fount of each respectively; Miss Margaret McMillan, in her section on woman's mission, is advanced, but sensible, as always; Mr. Joseph McCabe, on the humaner spirit, mentions reforms in the hours of labour, in the sanitation of prisons, in Parliamentary representation, and claims that not science, but humanistic idealism is the greatest phenomenon of modern times; Prof. J. S. Mackenzie writes on educational ideals, Mr. C. T. Gorham on the moral ideal, and Mr. G. Spiller on the future of religion.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Elasticity and Entomology.

WHILE Euler's problem of the buckling of elastic rods and shafts under end thrust has received much attention both from mathematicians and from engineers, the importance of the results does not appear to have been appreciated in the entomological world.

I have been recently attempting to rearrange an old butterfly collection mounted in the so-called "Continental" fashion, high up on entomological pins about 1·5 in. long, and I find that except in the case of the thickest pins elastic instability invariably occurs when it is attempted to insert the specimens in the cabinet. This effect causes great trouble and inconvenience even with pins of thickness suitable for mounting average-sized Lyceænidæ. The drawers of my cabinet are lined with peat, coated with a thin layer of cork, and are specially constructed for the purpose, so the resistance is not great.

In the case of brass pins "made in Germany" it is impossible to insert them from above without permanently bending, and often doubling them up. In this case the flexure due to buckling causes permanent "set." Steel pins, on the other hand, are not usually bent beyond the elastic limits, but the result of the buckling is to cause the end of the pin to take a wrong direction when it is driven into the box; consequently, when the forceps is removed, the insect springs back into a position different from that originally intended, not only causing the collection to look very unsightly, but often resulting in the antennæ breaking off in consequence of the momentum generated in them by the vibration. The effect of excessive strain in the case of steel would probably be to break the pin in two.

It is curious that when studying these problems in elasticity nearly thirty years ago the idea never occurred to me to apply the results to account for the incessant troubles and misfortunes which in later years resulted in my abandoning entomology as a hobby. The present experiences, affording as they do a theoretical explanation of the difficulties, prove conclusively that the Continental system of setting butterflies and other insects high up on long German pins is fundamentally wrong in principle, and entomologists would do well to take account of the phenomena of elastic instability in deciding the style in which they mount their future collections.

It would be the easiest thing in the world to calculate the maximum length of pin of a given thickness that could be driven without buckling into a cabinet drawer or store-box offering a given resistance, but the question is so easily decided by trial that a mathematical investigation appears scarcely necessary.

G. H. BRYAN.

Babylon's Sacred Way.

THE discovery of the Sacred Way, or Procession Street, of Babylon is one of the results of excavations carried out by Dr. Robert Koldewey on the site of this ancient city. This Sacred Street extended approximately north and south through Babylon so far as the south-east corner of a level quadrangular enclosure wherein was situated the famous Tower of Babylon. Here the Sacred Way turned sharply westward towards the Euphrates, where the stone piers of the bridge which spanned the river have been found. All the temples of Babylon, including those of the goddess Ishtar and of Marduk, the lord of Babylon, have been found in the vicinity of this Sacred Way on either side. The street was extended slightly west of north and east of south, and the temples were similarly oriented, the southward aspect being approximately S.S.E. Apparently no attempt has been made to ascertain the azimuth of any of the temples, or of the Procession Street. Prof. Leonard W. King, in his recently published "History of Babylon," states that "Nebuchadnezzar boasts that he paved the street of Babylon for the procession of the great lord Marduk, to whom he prays for eternal life" (p. 59).

The foundation of the Sacred Way was laid with burnt bricks. The pavement throughout its entire length was constructed of square slabs, those in the middle being "a fine hard limestone," those along each side being of "red breccia veined with white"; but along that part of the Sacred Way between the royal palace and the main entrance to the enclosure of the Tower of Babylon the pavement was formed entirely with slabs of breccia. A plate facing p. 60 of the "History," showing part of the Procession Street uncovered, makes it appear that the slabs were about 18 in. square. They were held firmly in position by being laid on bitumen, which also filled the interstices between the slabs.

Dr. R. Koldewey thinks the limestone may have been obtained from Hit, on the Euphrates. Prof. L. W. King has informed me, in reply to an inquiry, that "it is not yet known whence the breccia for the Sacred Way was obtained, though at the time of its discovery Dr. Koldewey consulted more than one geologist on the subject."

Inscriptions on the edges of the slabs record that the pavement was constructed by Nebuchadnezzar (604–561 B.C.); but it is recorded on many of the slabs of breccia that they had formed part of an earlier pavement which had been the work of the great Sennacherib (688–681 B.C.) during the Assyrian domination. It would be interesting to know from what quarries the breccia and the limestone were obtained.

By his extremely valuable "History of Babylon," Prof. L. W. King has placed archæologists and all interested in ancient civilisations under a heavy debt of obligation. The long chapter dealing with the most recent discoveries, with numerous plans and illustrations, is a treatise in itself of thrilling interest.

H. KIDNER.

194 Shelbourne Road, Bournemouth.

P.S.—Since the foregoing letter was in type I have made a closer examination of the plans of the city and of its temples, published in Dr. King's "History of Babylon."

The plans on pp. 74 and 83 show that the part of the Sacred Way leading to the Euphrates branched from the main street at an angle of about 87°. This part of the street was oriented about 10° to 12° N. of E. and S. of W. The street passed alongside the eastern and southern wall of the peribolos of the Temple Tower, and in this latter part of its course towards the river it had the tower on the right (N.) and the Temple of Marduk on the left (S.). Prof. King states that the main street doubtless also continued southwards to a gate in the southern wall of the city.

The temples are quadrangular structures enclosing one or more courts open to the sky, and they all agree in having the eastward side more or less north of east, the western side facing south of west. But the orientation varies considerably. Thus while the Temple of Ishtar is oriented almost due N. and S. and E. and W., facing only about 4° N. of E., the Temple of Ninib faces about 20° N. of E., and the Temple of Ninmakh some 25° N. of E. This latter temple has its entrance on the northerly side, and the shrine on the southern, whereas the Temple of Ishtar has entrances on the E. and S. sides, and the shrine on the W. The figures given are approximate only.

Dr. King is now at work on the third volume of his "History," each volume treating of a separate period, and being to some extent independent of the others. When completed the work will be of lasting value, although each year adds fresh knowledge from new discoveries. Dr. King teaches us much, but he also makes us feel how much there is to learn. What principles, for instance, guided the Babylonian architects and builders in the orientation of their temples?

June 12. H. K.

"Ptolemy's Catalogue of Stars."

MAY I point out that your reviewer of "Ptolemy's Catalogue of Stars" (June 1, p. 282) is mistaken in suggesting that a mere confusion between the uncial alpha (=1) and the uncial delta (=4) will account for Ptolemy's assignment of the first magnitude to what is now the third-magnitude star, θ Eridani?

The star, called "the last in the River," whence the Arabic name of Achernar, is expressly described in the catalogue as "brilliant," λαμπρός, an epithet applied to no other in the group. And in another work of Ptolemy's, the Φάσεις, in which the risings and settings of thirty "fundamental" stars, fifteen of the first magnitude and fifteen of the second, are calculated for several parallels of latitude, "the last of the River" takes its place among those of the first magnitude.

Moreover, the same star is mentioned several times by Hipparchus in his one surviving work, the commentary on Aratus, and in each case it is described as the brightest in the constellation of the River, which it could not have been had it been of the fourth magnitude only.

Again, the star is of the first magnitude to Al Sûfi, whose catalogue was drawn up, 800 years after Ptolemy, for the express purpose of revising the magnitudes given in the Almagest. Al Sûfi adds some particulars as to its position which alone would suffice to refute the wild suggestion that the star meant was, not θ, but the modern α Eridani, Achernar, a star invisible to Greek and Arab astronomers.

There can be no reasonable doubt that θ Eridani has declined in lustre, from the first magnitude to the third, in the interval between Al Sûfi and the days when, during the early Portuguese voyages, it again was seen, after many centuries, by European eyes. That Ulugh Beg, 1437, should still make it a first-magnitude star is remarkable, but not conclusive, as his work was a revision of the places only, not the magnitudes, assigned to the stars by his predecessors.

E. J. WEBB.

Noke, Islip, Oxford.

THE suggestion was not made by the reviewer, but is made in the work under review (p. 110), where it is stated that "it is most probable that in a very ancient manuscript the delta = 4 was erroneously taken to be an alpha = 1, of which the present investigation shows numerous examples." As regards the statements of Hipparchus, Ptolemy, and Sûfi, the facts are:—

	Lat.	θ Eridani Decl.	θ Eridani Zen. dist.
	°	°	°
Hipparchus, Rhodes ...	+36 ...	−50 ...	86
Ptolemy, Alexandria ...	+31 ...	−48 ...	79
Sûfi, Bagdad	+33 ...	−45 ...	78
Shiraz	+30 ...	−45 ...	75
Teheran	+35 ...	−45 ...	80

Sûfi, on account of the low altitude, took the magnitude from Ptolemy. That θ Eridani was of the first magnitude for more than a thousand years, and from the time of Halley (1677) to the present day of uniform brightness (3 or 4 mag.), without sign of variability, will scarcely be accepted by astronomers.

THE REVIEWER.

Meteorological Conditions of a Blizzard.

YOUR correspondents are entirely right in their contention that, in this country, the word "blizzard" is used as a rule quite wrongly. I have protested many times in the past against this misuse.

For various reasons, a true blizzard cannot occur in Britain. In the first place, as several correspondents have already pointed out, the necessary climatic conditions are lacking; for a wind of extremely high velocity never occurs here in conjunction with sufficiently intense cold, producing fine dry powdery driving snow. Secondly, a wind-velocity sufficiently high to produce a blizzard is seldom or never attained, except in a region marked by an immense extent of level surface, little broken by trees and other obstructions, and there is no such region in Britain. All the necessary conditions, both climatic and physical, exist, however, in that true home of the blizzard—the vast plains and prairies lying to the east of the Rocky Mountains, in Central North America, especially in Dakota and Manitoba. Even the great English snowstorm of January 18, 1881 (which I remember very well indeed), bore little resemblance to a true blizzard, for the intense cold and high wind-velocity characteristic of a blizzard were both absent.

Those interested in the subject could not do better than refer to a little work, "Manitoba Described," which I published in 1885, after a visit to that country. Therein will be found (pp. 57–58) an excellent description of a Manitoban blizzard, written by my friend Mr. Ernest Thompson Seton, then living there. It was, I believe, the earliest description ever published, at all events in this country. Moreover, its graphic style has never been, and could not be, excelled.

It may be worth mentioning—though the point is of etymological rather than of scientific interest—that the use of the word "blizzard" in the above-mentioned article (1885) marked, I believe, its first appearance in permanent literature in this country, though there are instances of its use three or four years earlier in English periodical literature. Earlier than that the word cannot have been used anywhere in the sense in question; for it did not make its appearance, even in American journalism, before the winter of 1880–81.

MILLER CHRISTY.

Broom Wood Lodge, Chignal St. James,
Chelmsford, June 13.

THE OVER-FISHING OF THE NORTH SEA.[1]

THE problem of over-fishing of the North Sea was stated in general terms by several committees of inquiry during the latter decades of the last century, and particularly, in regard to the fishes of which the plaice is the type, by the International Council for Fishery Investigations about ten years ago. Since then a large amount of scientific and statistical research has been carried on in this and other European countries with the object of providing data for international schemes of fishery regulation. A series of reports recently published by the English Board of Agriculture and Fisheries forms what is obviously a very important contribution towards the settlement of these very difficult questions. The series includes three papers on the routine work dealing with the age, growth, and sexual maturity of the North Sea plaice, with the food of the fish in different areas and at different times, and with the distribution of the sexes. These reports have been prepared by Dr. W. Wallace, Mr. R. A. Todd, and Mr. A. E. Hefford. Miss R. M. Lee reviews an extensive series of commercial trawler statistics dealing with plaice, soles, and haddock; and Lieut. H. J. B. Wollaston gives an account of investigations undertaken with the object of delimiting the positions of plaice-spawning grounds in the North Sea. These two latter papers are distinguished by much originality of treatment, clear and orderly presentation of the facts elicited, and readable discussions of the trend of the data. They contain some noteworthy results: interesting cases of high statistical correlation between the density of plaice and haddock on the various fishing grounds of the North Sea, established by Miss Lee; and details of some novel methods of plankton investigation devised by Lieut. Wollaston.

The main problem is discussed by Dr. A. T. Masterman. Is there evidence of indubitable over-fishing of the North Sea? In its inception the problem was an international one, and it has, to some extent, been treated as such. But the English trawl-fisheries are so predominant as to make it apparent that the statistical data obtained by the Board of Agriculture and Fisheries must form the main mass of material to be considered. The returns of plaice landed at English ports during the period 1906–1912 are therefore those dealt with by Dr. Masterman. Nevertheless the report to the International Fishery Investigations Council prepared by Dr. Heincke, and published in the seventeenth volume of "Rapports et Proces-Verbaux," should also be seen by readers of the present papers.

Dr. Masterman's report is difficult to read because of the great mass of detail considered. The statistics are complicated rather unnecessarily (in the meantime at least) by the rather minute subdivision of the North Sea into statistical areas, nineteen in all. If the areas are considered individually the fishery statistics of other North Sea nations must be included, and this has not been attempted—perhaps it is impracticable. Now the period of time covered by the investigations, 1906–1912, is far too short to enable us to decide whether over-fishing has actually occurred. There are fluctuations during this period, and these "maximal and minimal years" are not the result of statistical "accidents," for they are demonstrated independently by Miss Lee's data. But they are fluctuations most probably dependent on, or to be associated with, meteorological cyclical events, and do not bear on the question of over-fishing.

Perhaps over-fishing has been demonstrated by Dr. Masterman as the result of the consideration of the "trade-categories." Plaice landed in England are subdivided into "large," "medium," and "small." The variation in the total annual quantities of all plaice landed during 1906–1912 is not significant, but there is a significant decrease in the quantity of "large," and a compensatory increase in the quantity of "small." These variations in the quantities belonging to the various classes may be unreal, for there are apparently no statistical descriptions of the "categories," and it is not impossible that these have not always been the same throughout the period considered. The terms are trade ones, and the classification is a trade convention made independently of the system of statistical collection. Nevertheless it is most probably true that modern trawl-fishing has diminished the stock of large plaice inhabiting the North Sea: Dr. Masterman's discussion indicates so much. The composition of a natural fish-population inhabiting this very extensive area has been affected by artificial means. In other words, the "mean after-lifetime" of a plaice inhabiting the North Sea, at the time when it is big enough to be caught in a trawl-net, has been reduced as a result of the development of the British steam-fishing fleets.

The problem is thus one of the eliciting of facts rather than of the provision of remedial legislative measures. It is highly unlikely that such will be attempted for some time to come, but the thing to be immediately considered is the recommendation made to the various Governments, in 1913, by the International Fishery Investigation Council. This suggested a minimum size-limit upon plaice landed of 20 cm. during the winter months, and of 22 cm. in the summer months. Now one must consider rather carefully what is meant by "over-fishing." The natural problem that confronts sea-fishery authorities is to get as great a quantity annually of *marketable plaice* from the North Sea as this area will afford without progressive depletion of its resources. The commercial value of this annual yield must not alone be considered, nor the relative value of one fraction of it (large plaice) as against another fraction (small plaice). Other questions incidental to the general one, such as the effect of the proposed legislation upon the commercially unorganised smaller inshore fisheries, must also be considered. These considerations are, of course, not relevant to Dr. Masterman's discussion, but they ought to be in the minds of readers of these important papers.

J. J.

[1] Board of Agriculture and Fisheries. Fishery Investigations. Series II., Sea Fisheries. Vol. ii., Nos. 1–5; Vol. iii., Nos. 1–2. (London: H.M. Stationery Office, 1915.)

INHERITANCE IN ROVING AND IN ROMANTIC TYPES.[1]

In his interesting study Dr. Davenport deals first with those not unfamiliar types who cannot settle down, who run away from home and school, who disappear suddenly and are next heard of at the ends of the earth. When the impulse is well-marked those whom it sways are known as rovers, and the periodic or prevailing domination of life by the wandering impulse may be called nomadism. It occurs in various forms and degrees, but the term nomadism should not be used too widely if it is to be of any use. Thus Meunier's classification includes legitimate nomads (like peddlers and missionaries), delinquent nomads (like fugitives from justice), nomads of ethnic origin (like gipsies and crusaders), as well as nomads of morbid origin (who are "rovers" in the strict sense). But this net has been too widely cast, and the suggestion that the rovers are necessarily morbid is unfortunate. The truant may become a scholar-gipsy and the stowaway a great explorer.

According to Dr. Davenport, "nomads, of all kinds, have a special racial trait—are, in a proper sense, members of the *nomadic race*. This trait is the absence of the germinal determiner that makes for sedentariness, stability, domesticity." From the data of a hundred family histories (some of which seem to us far from convincing as illustrations of true roving), the investigator concludes that

> nomadism is probably a sex-linked recessive monohybrid trait. Sons are nomadic only when their mothers belong to nomadic stock. Daughters are nomadic only when the mother belongs to such stock and the father is actually nomadic. When both parents are nomadic, expectation is that all children will be.

The wandering impulse is frequently associated with various kinds of periodic behaviour, such as depression, migraine, epilepsy, and hysteria, but Dr. Davenport is probably right in concluding that these merely permit the nomadic impulses to assert themselves. We do not feel at all convinced, however, by the argument that nomadism in man is of the same order as the regularised restlessness of migratory birds, or that it is the reassertion of a fundamental human instinct, normally inhibited by the conditions of civilisation.

The second study deals with the inheritance of temperament, more especially of the "romantic" and "classic" types, that is to say, the quickly-reacting and the slowly-reacting, the feebly-inhibited and the strongly-inhibited. In the old terminology the choleric and nervous were contrasted with the phlegmatic and melancholic; in the new terminology the "hyperkinetic" are contrasted with the "hypokinetic." Politically, Dr. Davenport tells us, the contrast spells radical and conservative; in any case, the dualism runs through our whole population.

The investigator is well aware that our temperamental outlook is profoundly affected by a complexity of conditions, such as the secretion of the suprarenal bodies, the blood-pressure, the state of the arterial walls, the adequacy of digestion and toxin-elimination, the state of the eyes (as Gould's well-known studies show), as well as by such unconsidered trifles as an ambition, a passion, an enthusiasm, an ideal; but he is not afraid to launch the hypothesis that there is in the germ-plasm a factor, E, which makes for excitability, while its absence means calm; that there is another factor, C, which makes for cheerfulness, while its absence "permits a more or less periodic depression."

This hypothesis is supported by an analysis of the pedigree-charts of eighty-nine families. There is interesting evidence of similarity of temperament in "identical twins." As regards marriage it is pointed out that "these twain" rarely have "the same zygotic temperamental formula," which is doubtless providential. As regards suicide it is shown that the hyperkinetic and the hypokinetic types are consistent even to the end, for they keep to their distinctive methods. The factorial hypothesis seems to work well in certain cases, but we must confess that the theory of a factor C, "which makes for normal cheerfulness of mood," appears to us an incredible simplification of the facts of life.

[1] "The Feebly Inhibited. Nomadism, or the Wandering Impulse with Special Reference to Heredity. Inheritance of Temperament." By C. B. Davenport. Pp. 158. (Washington: Carnegie Institution, 1915.)

PROF. SILVANUS P. THOMPSON, F.R.S.

The sudden and unexpected death of Prof. Silvanus Thompson will be deeply regretted by a large and distinguished circle of personal friends, as well as by the many engineers, electricians, and others who, either directly in his classes, or indirectly through his books and writings, have come under the influence of his teaching. A many-sided, cultivated, and highly gifted man of untiring industry, possessed of an almost unique knowledge, not only of the highways and byways of science itself, but also of its history and the history of its creators, Prof. Thompson held a distinguished position in the scientific world.

During the past three centuries scientific facts have been accumulating so rapidly and on so vast a scale that no one could to-day honestly pretend, with Francis Bacon, that he took all knowledge for his province. Nor would it be possible nowadays for any single individual to be, like Leonardo da Vinci, the master, not only of every branch of science and engineering, but also of literature and the arts. Prof. Thompson, however, if he fell short of reaching the unattainable, was a real master in many separate intellectual fields. In the sciences of electricity, magnetism, and optics, and in other branches of physics, he made discoveries and did original work of his own, besides much other work in the way of elucidating and popularising what was done by others. Gifted with a peculiar charm of manner, a pleasantly resonant voice, great clarity of diction, and an immense facility for finding the proper words and expressions, his lectures were always a pleasure to listen to, particularly as, in addition to his

powers of locution, he was also exceedingly successful with his experiments. His speeches, whether prepared or extempore, were always models of lucidity, and when moved he was capable of attaining to real eloquence. From a combined scientific and literary point of view he possessed not a few points of resemblance with Tyndall, though very different himself in other ways from Tyndall as a man.

The late Sir William White, himself a very fluent and effective speaker, and himself a no mean judge of oratory, once told the present writer that he had heard Prof. Thompson deliver an address at a religious meeting in the Friends' Meeting House at York, and that it was the best sermon he had ever heard in his life. Nor were Prof. Thompson's powers of speech limited to his own language, as he was equally at home both in conversation, and when speaking in public, in the French, German, and Italian languages. In his writings also he showed himself to be a master of English. If the subject was scientific his language was always extraordinarily clear and to the point, which explains the remarkable success of some of his books. His treatise on "Dynamo Electric Machinery," for example, which was first published in 1884, has run to seven English editions and has further been translated both into French and German. Again, his "Elementary Lessons in Electricity and Magnetism" has been translated into French, German, Italian, Polish, and Japanese, and, in addition, has had a circulation of more than one hundred and fifty thousand copies in this country; while other of his technical books, such as his "Electro-Magnet," his "Polyphase Electric Currents and Motors," and his "Light, Visible and Invisible," together with many of his other scientific writings and lectures, have met with world-wide success.

To turn to Prof. Thompson's efforts of a more purely personal character, his fine literary style was turned to good use in his life of Faraday, his biographical notice of Philip Reis and his telephone, and his recent two-volume "Life of Lord Kelvin." Then, again, he was always keenly alive to the historical side of science, particularly from a romantic point of view, as is seen from the large amount of time and labour that he devoted to old books, such as the "De Magnete" of William Gilbert of Colchester, physician to Queen Elizabeth, which book he assisted to translate. He also devoted attention to, and reprinted, some of the seventeenth-century works on magnetism of Robert Boyle. Mention should also be made of the translation he made from the original Latin of the epistle on magnetism of Peter Peregrinus, written in the year 1269 by a soldier in the trenches during a siege, which translation he caused to be privately printed, ornamenting the coloured initial letters with his own hand. For, in addition to being a man of science and a man of letters, Prof. Thompson was also an artist who was able himself to draw the portrait of Faraday that illustrates his life of that great man, and whose water-colours of Alpine scenery have appeared on the walls of the Royal Academy.

As a man Prof. Thompson was a genial and interesting companion of wide general interests and sympathies. He lived up to the high standard of the Society of Friends, of which he was a lifelong member, and was, indeed, a very good and true friend to many, to whom he tendered a helping hand in his quiet unostentatious way. Perhaps his chief characteristic was his amazing industry, and it is to this that is due the vast amount of work that he accomplished, though, passing away as he did at less than sixty-five, he has not attained even to the three score years and ten of the Psalmist, much less to the four score years which are now so commonly surpassed by many of our grand old men of science.

Few of the many who attended the service "For Worship," in memory of Prof. Thompson, on Friday last, in the Friends' Meeting House, St. Martin's Lane, will readily forget that remarkable and moving occasion. Many of the veterans of British science were there assembled, and the complete absence of any approach to form or ceremony, and the austere simplicity of the proceedings, were very impressive and carried one back to the days of the Puritans. Such was a fitting finale to a strenuous and distinguished career, by the close of which science has lost an enthusiastic leader and an illuminating exponent. Amongst those who knew Prof. Thompson personally all will deplore the departure of a trusted and very sincere friend —one who will not readily be forgotten.

A. A. CAMPBELL SWINTON.

WHAT SCIENCE SAYS TO TRUTH.

AS is the mainland to the sea,
Thou art to me:
Thou standest stable, while against thy feet
I beat, I beat!

Yet from thy cliffs so sheer, so tall,
Sands crumble and fall;
And golden grains of thee my tides each day
Carry away.

WILLIAM WATSON.

NOTES.

WE regret to see the announcement of the death on June 18 of Dr. R. H. Scott, F.R.S., superintendent of the Meteorological Office from 1867 to 1900.

THE longevity of men of science has often been brought under notice. On Saturday next, June 24, the Rt. Hon. Henry John Moreton, Earl of Ducie, F.R.S., enters on his ninetieth year, having been born in 1827. His lordship is the senior fellow of the Royal Society in point of election to that body, this dating from 1855. When Lord Moreton, he obtained from the Jurassic limestone of Burford the fossil species of star-fish named by Prof. Edward Forbes *Solaster moretoni*, in honour of the finder. In connection it may be mentioned that Sir Robert Palgrave, F.R.S., entered on his ninetieth year in the early part of this month, while Sir William Crookes attained the age of eighty-four on Saturday last, June 17.

DR. AXEL GAVELIN has been appointed director of the Swedish Geological Survey.

THE Sulitelma Company has made a grant of 20,000 kronen (about 1100*l.*) to assist geological research in Norway.

A CORRESPONDENT of *Svenska Dagbladet* states that in the Berlin Zoological Gardens carnivores are fed no longer on horseflesh, but on general offal obtained in the slaughter-houses, especially those of large preserving factories, and other places. Animals formerly fed on oats are now given various roots, and it is found that they appreciate these much better when boiled.

THE special correspondent of the *Times* at Port Stanley (Falkland Islands) reports that the ship sent by the Uruguayan Government for the relief of the members of Sir Ernest Shackleton's expedition on Elephant Island left there on Saturday, June 17.

AT a recent meeting of the Optical Society the president (Mr. F. J. Cheshire) stated that it had recently been discovered by a well-known London optician that the apochromatic systems of Carl Zeiss often, if not always, contained a strong negative lens made from ordinary potash alum. This lens had also been found in combination in such systems with a lens made from fluorspar.

A SCIENTIFIC lawyer writes:—"In the legal profession the axiom that 'a man who gets his law for nothing feels that he has got his money's worth' has assumed the purple among accepted facts." On this principle the best way to secure appreciation for the expert knowledge which men of science are continually giving gratuitously to Government departments would be to require reasonable payment for it.

THE death is announced, in his sixtieth year, of Mr. C. Sooysmith, consulting engineer, of New York, who introduced into the United States the so-called freezing process for excavating, and took out many patents for its application to the building of subaqueous tunnels. He also inaugurated the pneumatic caisson method for constructing the foundation of high buildings, and constructed the foundation for a number of large bridges, including the bridge over the Schuylkill River at Philadelphia and the Harlem River bridge at New York.

AT the annual meeting of the American Association for the Study and Prevention of Tuberculosis it was announced that it had received from the Metropolitan Life Insurance Co. a gift of 20,000*l.* for a "community experiment," with the idea of proving that tuberculosis can be controlled. First, there is to be selected a suitable community, of a character as nearly typical American as possible. In this community will be placed a staff of experts, who will get in touch with every person living within its boundaries who either has tuberculosis or has been exposed thereto. The staff will then, it is hoped, get every case under supervision, and control the disease in that particular town. The experiment is to last three years.

THE President of the Board of Trade has appointed a Committee to investigate the principal causes which have led to the increase of prices of commodities of general consumption since the beginning of the war, and to recommend such steps, if any, with the view of ameliorating the situation as appear practicable and expedient, having regard to the necessity of maintaining adequate supplies. The Committee is constituted as follows:—Rt. Hon. J. M. Robertson, M.P. (chairman), Mrs. Pember Reeves, Mr. W. C. Anderson, M.P., Prof. W. J. Ashley (professor of commerce, University of Birmingham), Mr. John Boland, M.P., Mr. T. Brodrick, Sir Gilbert Claughton, Bart., Mr. J. R. Clynes, M.P., Mr. R. E. Prothero, M.P., Mr. T. Shaw, J.P., and Sir W. Capel Slaughter. Mr. E. C. Ramsbottom, of the Board of Trade, will act as secretary to the Committee.

THE death is announced on June 13 of Commander C. B. Neate, R.N. Commander (then Lieutenant) Neate was the head of the British expedition to Rodriguez, in the Indian Ocean, for the observation of the transit of Venus in 1874. Three stations in the island were occupied, Lieut. Neate himself being at Point Venus, where all contacts were successfully observed. The "black drop" was seen, both at ingress and egress. At ingress the whole planet was distinctly seen outside the sun's limb, the following limb of Venus being bright, "like a very young moon." The observations are fully described and illustrated in the volume edited by Sir G. B. Airy, and published in 1881. Lieut. Neate was also a member of the expedition for the transit of 1882, being stationed at Bermuda, where, however, owing to cloud, the observations were only partially successful.

IN some agricultural districts the times at which labourers commence work have been advanced by one hour, thus cancelling the operation of the Summer Time Act. The reason given for this action is that at the earlier hour there is too much dew to enable farm work to be carried on. The advantage of the later lighting-up time in houses is also apparently to be discounted by an increase in the cost of artificial illumination, for the Brompton and Kensington Electricity Supply Co., Ltd., has just made the following announcement:—"In consequence of the operation of the 'Daylight Saving' Act, and in furtherance of the appeal of the Board of Trade to economise as far as possible in the use of electricity and gas (owing to the need for reducing the consumption of coal), the price of current will be increased by a further 10 per cent., to take effect from the date of reading the meters at the end of the current quarter." Other companies are also making this additional charge, which means that consumers will now have to pay a 20 per cent. increase on the cost of the units used, as there has been for some time an increase of 10 per cent. upon the pre-war rate. Whatever economy is effected in the consumption of current and gas by the introduction of the Daylight Saving measure will not, therefore, be to the advantage of the consumer, who will, under the increased rate, have to pay much the same for illumination as in corresponding periods before the Act came into force.

THE Standing Committee on Engineering appointed by the Advisory Council for Scientific and Industrial Research held its first meeting on Wednesday, June 7. The Committee has been so constituted as to represent both the scientific and the industrial sides of engineering, and includes the following members nominated by the professional associations:—Institution of Civil Engineers, Sir Maurice Fitzmaurice; Institution of Electrical Engineers, Mr. J. S. Highfield; Institution of Mechanical Engineers, Dr. Dugald Clerk; Institution of Naval Architects, Sir Archibald Denny, Bart.; N.E. Coast Institution of Engineers and Shipbuilders, Mr. Herbert Rowell; Manchester Association of Engineers, Mr. Alfred Saxon; Institution of Engineers and Shipbuilders in Scotland, Mr. James Brown; and the following members appointed directly by the Advisory Council:—Mr. F. R. Davenport, Mr. Alfred Herbert, Prof. Bertram Hopkinson, F.R.S., Mr.

C. H. Merz, Mr. V. L. Raven, Mr. A. A. Remington, Mr. G. Gerald Stoney, F.R.S., Mr. Douglas Vickers, Prof. Miles Walker. The Advisory Council has appointed Sir Maurice Fitzmaurice to be chairman of the Committee.

The formation by the Advisory Council for Scientific and Industrial Research of a Standing Committee on Mining, constituted so as to represent both the scientific and industrial sides, has now been completed. The Standing Committee includes the following members nominated by professional associations:—Institution of Mining Engineers: Sir William Garforth, Dr. John Haldane, Dr. R. T. Moore, Mr. Wallace Thorneycroft; Institution of Mining and Metallurgy: Mr. Edward Hooper, Mr. Edgar Taylor; Iron and Steel Institute: Prof. H. Louis; the South Wales Institute of Engineers: Mr. W. Gascoyne Dalziel; and the following members appointed directly by the Advisory Council:—Sir Hugh Bell, Bart., Mr. Hugh Bramwell, Lieut.-Col. W. C. Blackett, Prof. Cadman, Prof. Frecheville, Mr. Bedford McNeill, Mr. Hugh F. Marriott, Sir Boverton Redwood, Bart., Mr. C. E. Rhodes. The Advisory Council has appointed Sir William Garforth to be chairman. The Committee is divided into two sections, as follows:—*Section on the Mining of Iron, Coal, and Hydrocarbons*: Sir William Garforth (chairman), Sir Hugh Bell, Bart., Mr. Hugh Bramwell, Lieut.-Col. W. C. Blackett, Prof. Cadman, Mr. W. Gascoyne Dalziel, Dr. John Haldane, Prof. Louis, Dr. R. T. Moore, Sir Boverton Redwood, Bart., Mr. C. E. Rhodes, Mr. Wallace Thorneycroft. *Section on the Mining of Minerals other than Iron, Coal, and Hydrocarbons*: Mr. Edgar Taylor (chairman), Sir Hugh Bell, Bart., Prof. Frecheville, Mr. Edward Hooper, Prof. Louis, Mr. Bedford McNeill, Mr. Hugh Marriott.

General Joseph Simon Gallieni, whose death was recently announced at the age of sixty-seven, had achieved fame, not only as a soldier, but as an explorer and colonial administrator. In 1880 he ascended the Senegal and explored the course of its two principal tributaries, the Ba-Khoy and the Ba-Fing, and the hitherto unknown regions between the Senegal and the Niger, and then descended the Niger to Segu Sikovo. Seven years later he was again exploring in the same region, and his work had much to do with the extension of French influence in the western Sudan and Timbuctu. In 1892 Colonel Gallieni was sent to Tongking, and combined much topographical work with his arduous military duties. But perhaps the most difficult task he ever undertook, and the one in which he was most successful, was his governorship of Madagascar. In nine years he rescued that island from a state of chaos and turned it into a possession worthy of France. Roads and a railway were built, agriculture put on a firm basis, mining was developed, and education taken in hand—to mention but a few of General Gallieni's works. Lastly, a detailed survey of Madagascar was commenced. General Gallieni distinguished himself in the Franco-German war of 1870, and in the present war was entrusted in September, 1914, with the defence of Paris at a time when the enemy's forces were advancing. This task General Gallieni was happily spared by the repulse of the enemy at the Marne.

A summary of the weather for the spring season for the several districts of the United Kingdom, collated by the Meteorological Office from the weekly returns for March, April, and May, shows that beyond an excessive amount of rain the conditions were fairly normal in spite of the fickle character of the weather. The mean temperature was below the normal in all districts except the north-east and east of England, but the deficiency was small, except in Ireland, where it amounted to nearly 2° F. Rainfall was in excess of the average, except in the north of Scotland, where the deficiency was only 0·04 in. The most abnormal rainfall was 153 per cent. of the average in the east of Scotland. Sunshine was deficient over the entire kingdom. Summer has commenced with exceptionally cold weather over the whole of the British Isles. The London reporting station of the Meteorological Office at South Kensington has no day temperature higher than 65° from June 1 to 16, the mean of the maximum readings for the period being 59·5°, which is the normal for the middle of April or October. It is 6° lower than the average of the day temperature in May last, and is only 1° warmer than the average maximum for last April. Several days have been colder than on some days in January last. The Greenwich records only show one colder June day in the last seventy-five years than June 12 this year, when the thermometer did not exceed 50°, the exception occurring on June 19, 1903. Only three Junes in the last seventy-five years have failed to record a London temperature of 70° in the first sixteen days; the exceptions are 1909, maximum 68°; 1860, maximum 67°; and 1843, maximum 69·9°.

The Executive Council appointed for the purpose of carrying on the management of the Imperial Institute under the Secretary of State for the Colonies has been constituted as follows, the members being appointed by the Departments, Ministers, and Governments named:—*Board of Trade*: Sir W. H. Clark, K.C.S.I., Mr. H. Fountain. *Secretary of State for India*: Sir J. P. Hewett, Mr. L. J. Kershaw. *President of the Board of Agriculture and Fisheries*: Sir Sydney Olivier, K.C.M.G. *Government of India*: Sir R. W. Carlyle, K.C.S.I. *Government of the Dominion of Canada*: Sir G. H. Perley, K.C.M.G. *Government of the Commonwealth of Australia*: Mr. Andrew Fisher, High Commissioner for Australia. *Government of the Union of South Africa*: Mr. Philip Schreiner, High Commissioner for South Africa. *Government of the Dominion of New Zealand*: Sir T. Mackenzie, K.C.M.G., High Commissioner for New Zealand. *Secretary of State for the Colonies*: Lord Emmott, Director, War Trade Department; Lord Islington, Parliamentary Under-Secretary for India; Lord Scarbrough, chairman, the Niger Co., Ltd.; Lord Burnham; Sir Algernon Firth, president, Association of Chambers of Commerce of United Kingdom; Sir Owen Philipps, K.C.M.G.; Sir W. Taylor, K.C.M.G., formerly Resident-General, Malay States; Sir M. F. Reid, chairman, Bombay Chamber of Commerce (on the recommendation of Secretary of State for India); Prof. W. R. Dunstan, director, Imperial Institute; Mr. R. Threlfall, formerly professor of physics in the University of Sydney, N.S.W.; Mr. R. M. Kindersly, director, Bank of England; Mr. D. O. Malcolm, director, British South Africa Company; Mr. G. E. A. Grindle, Colonial Office; Mr. T. C. Macnaghten, Colonial Office. The Government of Newfoundland will shortly appoint a representative on the Executive Council.

In the *Psychological Review* (vol. xxiii., No. 3) Mr. S. Bent Russell, in an article on "The Effect of High Resistance in Common Nerve Paths," discusses the means by which he thinks complex forms of behaviour may be interpreted in terms of nervous mechanisms, such as are generally admitted for the simpler forms of behaviour. His theory depends upon the assumption of the synapses, *i.e.* junctions or points of contact between neurons, as centres of resistance to the

nervous impulse, and is an attempt to make more concrete the way in which competing paths may operate. He shows how a synapse mechanism, *i.e.* a system of interrelated neurons connected with other systems similarly constructed, by the varying degrees of resistance at their junction may serve for the selective distribution of impulses, and for the linking of one impression with another in the formation of habits.

THE new volume of the *Anales* of the National Museum of Natural History of Buenos Aires (vol. xxvii., for 1915) contains a very varied series of contributions to our knowledge of the natural history of the Argentine Republic. Beginning with some observations on ants, by the director of the museum, Dr. A. Gallardo, it comprises several technical papers on entomology and botany, and deals with many other subjects, ranging from old maps of the River Plate and drawings of the fabulous beast known as the "succarath," to a detailed petrographical account of some granitic rocks. The exploration of a sepulchral cave on the coast of Chubut leads Dr. F. F. Outes to conclude that during the sixteenth and seventeenth centuries the Patagonians possessed only the bow and arrow as a weapon; that in the first third of the eighteenth century they began to use the imported horse, and then first employed the bolas. Photographs of well-preserved portions of three arrows, or javelins, provided with a stone tip, are given.

IN the Journal of the South African Ornithologists' Union for December, which has just reached us, Mr. C. F. M. Swynnerton gives a long account of his experiments with captive birds in regard to their choice of insect food. For the most part his experiments were made with butterflies and moths and their caterpillars, though wasps, beetles, and other insects were also used. The Lepidoptera included both the protectively coloured, edible species and the warningly coloured, nauseous species. He finds that birds will readily eat even the most nauseous forms if they are hungry, but their readiness to accept these, and their ability to retain them when swallowed, decrease rapidly as hunger is satisfied. Thus the warningly coloured species derive benefit from their coloration only when their avian enemies can afford to pass them by. Even those birds with the smallest capacity for eating nauseous insects are able to eat one or two with apparent impunity, and even eagerness, when their stomachs are empty and the appetite is good. A bird with a rapid digestion is able to go on eating the most nauseous insects indefinitely, with frequent short intervals for assimilation, provided that no more tempting insects are within reach to carry the filling of the stomach well beyond the point at which such nauseous morsels are usually refused. Discrimination between edible and nauseating forms, the author contends, comes by experience only, and not instinctively.

IN the *Kew Bulletin*, No. 3, ten new exotic fungi are described by Miss E. M. Wakefield. *Polyporus shoreae*, a serious disease of Sal (*Shorea robusta*), is illustrated by a photograph showing the large sporophore at the base of a tree-trunk in Bengal. *Cordyceps peltata*, a species parasitic on the larvæ of a Cryptorhynchus, which infests cultivated Codiæums in St. Vincent, differs from all other species in the very large spores, which, instead of breaking apart at every septum at maturity, only separate at the middle into two narrowly wedge-shaped halves. The description of the fungus is illustrated by text figures.

IN the *Journal of Botany* for April Dr. W. Botting Hemsley contributes a paper on the flora of the Seychelles and Aldabra, giving descriptions of new flowering plants collected mainly during Prof. J. Stanley Gardiner's Percy Sladen Trust Expedition in 1905. Fifteen new species are described in the present contribution, which includes the Rubiaceæ and the description of a new Impatiens drawn up in 1910 by the late Sir J. D. Hooker. Some emendations in synonymy are also made. In a short introduction Dr. Hemsley gives an account of the botanical collections made in the Seychelles since 1901, when the flora of the islands was being critically studied by the author.

A SUBJECT of considerable importance to officers is most clearly and simply treated by Mr. E. A. Reeves in a paper on "Night Marching by Stars" in the *Geographical Journal* for June (vol. xlvii., No 6.). A good deal has recently been published on the subject, but no one perhaps has to such an extent the happy way of Mr. Reeves of putting technicalities in simple language. This paper, based on a lecture delivered at the Royal Geographical Society, deals both with the methods of finding the bearings of stars at any time and the more practical issue of using these bearings in marching.

AN important paper in Swedish by V. Tanner, occupying more than 800 pages, describes the development and retreat of the continental ice in Finnish and Scandinavian Lapland (*Bull. de la Comm. géol. de Finlande*, No. 38, 1915). A good *résumé* in French is given. Numerous eskers have been examined, and the author points out that several of these have suffered since their formation from fluvioglacial erosion and deposition. He takes the view, now common, that the eskers arose in tunnels in or under the ice-sheet, the eskers with "centra," described by De Geer, from the Stockholm district being special cases of formation where the ice-front abutted upon a lake or sea. The author wishes to reserve judgment as to whether centra in the eskers of Lapland have been produced in the same manner. Good illustrations are given of the gorges cut by glacial waters during the epoch of ice-recession. The work represents field-observations, extending over several years, in a country sparsely inhabited, difficult to traverse, and of singular monotony from the scenic point of view. The glacial map forming plate i., which unfortunately has no place-names, sufficiently attests the author's industry, covering an area of 350,000 sq. kilometres, or some 135,000 sq. miles, between latitude 66° 30′ N. and the desolate tundras that bound the Arctic seas.

WE have received *Revista de la Academia de Ciencias*, etc. (vol. i., No. 1, May, 1916; Zaragoza), and "La Ciencia, La Universidad, y La Academia," the latter being an inaugural address by Dr. Zoel G. de Galdeano. Their principal interest is that they show that Spain is beginning to appreciate the value of the exact sciences.

As supplementing the information given in the note on the "Mineral Resources of Great Britain," vol. v., which appeared in NATURE of June 15 (p. 327), reference may be made to the account of the occurrences of molybdenum ores throughout the world which appeared in the Bulletin of the Imperial Institute, No. 2 of 1908. The information then published was brought up to date by a special circular, issued by the Imperial Institute in 1915, dealing with occurrences of molybdenite in the British Empire, which are either commercially productive or afford promise of becoming so. The collection and publication of information respecting the occurrence of economic minerals in the Colonies and India has for some years been a prominent part of the operations of the Imperial Institute.

In an address to the American Institute of Electrical Engineers, which is reproduced in the April number of the Journal of the Franklin Institute, Mr. J. D. Ball, of the General Electric Company, Schenectady, gave a *résumé* of the results obtained by him in his recent examination of the magnetic properties of steels and other materials. He finds that for pure materials the reluctivity when plotted against magnetising force H gives a straight line from H = 10 to 400, and that the hysteresis loss per cycle for such materials varies as the 1·6th power of the maximum induction. The deviations from these laws which have been found by other observers are due, he finds, to the use of impure or mixed materials. A mixture of two materials which follow both laws follows neither at high fields. In the case of steels the presence of scale on the surface is sufficient to account for the observed deviations from the two laws. The paper contains a number of tables and curves showing the magnetic properties of steel, cast-iron, and scale.

Smokers have hitherto been implored—or compelled through heavier taxation—to practise war economy by avoiding, or at least restricting their use of, tobacco. Now it seems that were one of the products of their indulgence to be collected they would become national benefactors in disguise. In an article in the *Chemical News* for June 2 Mr. B. A. Burrell points out that tobacco ash contains 20 per cent. of potash. A cigar, cigarette, and pipe of tobacco of ordinary sizes, weighing severally 106·5, 27, and 25·5 grains, will give ash containing respectively 6·5, 1·75, and 1·60 grains of potash. (We think that there must be some mistake in Mr. Burrell's figures, since in our experience ordinary cigarettes weigh eighteen to twenty to the ounce, whilst it is difficult to obtain more than fourteen "pipes" from an ounce of tobacco.) As regards the possibility of recovering this waste potash, Mr. Burrell found that from the smoke-room of a club 9¾ oz. of ash and unburnt tobacco could be collected in eight days; from the lounge of a large hotel 13 oz. in four days; from a large restaurant 2½ lb. in ten days, and from a music-hall (one-tenth part of the auditorium) 4 oz. after one performance. The tobacco consumed in the United Kingdom for the year ending March 31, 1914, would give approximately 13,359 tons of ash, containing 2672 tons of potash, which, at the pre-war price of kainit, would be worth nearly 51,000*l*.

In a paper read before the Federated Malay States Chamber of Mines in March last, Mr. J. B. Scrivener, geologist, discusses the situation in the peninsula created by the increased demand for tungsten. The peninsula is one of the chief world sources of this metal, which nearly always occurs in the form of wolfram—a mixed iron and manganese tungstate—contaminated with tin-stone. To get new supplies Mr. Scrivener concludes that two courses are open. The first is to encourage prospecting in new land and to do everything to encourage the Chinese miners going into the less known parts of the granite ranges. It is anticipated that it is unlikely that large quantities of pure tungsten ores will be found, but that mixed wolfram and tin-stone areas will be discovered. The second course is to improve the facilities for the magnetic treatment of this mixture with the separation of the wolfram. For this at present only two plants exist, and much wolfram contaminated with tin ore is lying idle because of the expense of sending it for treatment. Scheelite (calcium tungstate), which cannot be magnetically purified, is in a different category. It is certainly to be hoped that the Government will do all in its power to encourage the output of a metal the usefulness of which, both for war and peace purposes, is increasing every year.

The *Revue générale des Sciences* for May 15 contains an article by M. Zach in which he gives formulæ for the strength of flat rectangular plates encastré at the edges, and subjected to uniform pressure p. These formulæ are based on experiments made by Bach, and by the Naval Departments in Germany and the United States of America. The maximum bending moment occurs at the middle of the long edge of the plate, and is $\frac{pa^2}{12}$ if the ratio of breadth a to length b is greater than 1 : 3. The bending moment at the centre of the plate has a value less than half of this. For other ratios of $a:b$, the bending moments at the middle of the long edge and short edge respectively are $K_A\frac{pa^2}{12}$ and $K_B\frac{pb^2}{12}$, where K_A and K_B are factors having the following values:—

$a:b$	1 : 2·5	1 : 2	1 : 1·8	1 : 1·6	1 : 1·4	1 : 1·2	1 : 1
K_A	0·99	0·96	0·94	0·91	0·86	0·79	0·64
K_B	0·03	0·06	0·09	0·14	0·22	0·38	0·64

At the corners of the plate the bending moment reverses in sign. The subject is of considerable importance in connection with the design of bulkheads, and we believe that the results of other experiments which have been made in this country will be available shortly.

Under the title, "A Scheme for the Promotion of Scientific Research," a suggestive little volume by Mr. W. B. Priest was published by Messrs. Stevens and Sons, Ltd., Chancery Lane, London, E.C., in 1908 (see Nature, January 21, 1909, vol. lxxix., p. 345). The scheme is based on the Patent Acts, and, according to it, any person who had made a scientific discovery of a prescribed description could apply for a grant of money, the application being accompanied by a specification of the discovery. The formation of the Committee of the Privy Council for Scientific and Industrial Research has led Mr. Priest to adapt his scheme to the work of this Committee; and he has sent us a copy of a communication made by him to the Advisory Council upon the matter. One of the chief difficulties which the Council has to meet is that industrial firms are unwilling to make known valuable results of researches in their works without adequate safeguards for the protection of their interests. Mr. Priest shows in detail how his scheme may be used for this purpose, and we have no doubt it will receive careful consideration from the Advisory Council.

OUR ASTRONOMICAL COLUMN.

The Solar Activity.—The large spot group (Nature, June 8) is again visible, and can be easily seen with binoculars screened with smoked glass.

Comet 1916*a* (Neujmin).—A possible connection between this comet and Encke's comet has been traced by H. Svoboda. A comparison of their orbit elements indicates that Neujmin's comet originated in the path of Encke's comet, possibly by a partition of the latter.

The Shower of Perseid Meteors.—There is evidence that the Perseids begin to appear during the last week in June, and that the whole duration of the shower extends over ten weeks.

This year there will be a favourable opportunity for making observations, the moon being only slightly in evidence between June 25 and July 7. If any streaking meteors are seen during this interval directed from the region of Andromeda, near the stars 37 and

theta, they should be carefully recorded. Duplicate observations of the same meteors will be very valuable, and will probably supply the data from which the question of duration may be finally answered. The computed place of the radiant is as follows:—

		° °			° °
June 25	...	358+33	July 1	...	2+39
26	...	358+34	2	...	3+40
27	...	359+35	3	...	3+41
28	...	0+36	4	...	4+42
29	...	0+37	5	...	5+43
30	...	1+38	6	...	6+44

SELENIUM PHOTOMETRY.—Prof. J. Stebbins describes his important work in connection with the employment of selenium bridges in astronomical photometry in the current number of the *Observatory*. This doubtless forms a completed chapter in the story of the electrical measurement of radiation, since Prof. Stebbins has for some time directed his attention to the later photo-electrical methods (NATURE, May 4). It may be remarked that there is a somewhat misleading reference to Prof. Minchin's work in the brief historical statement, as the "*cell*," properly so called, devised by him was based on a quite different principle from that of the bridges used by Prof. Stebbins. Moreover, the first essays in the application of Prof. Minchin's selenium cell to stellar photometry were made by Mr. Monck and Prof. Fitzgerald in 1892, at Dublin. Afterwards Prof. Minchin greatly increased the efficiency of his apparatus, and himself made measures of stellar radiation in 1895 at Daramona.

THE CHEMICAL ORIGIN OF SOLAR RADIATION.—This question is discussed by Dr. Briner in the *Revue générale des Sciences*, No. 9. The adequacy of purely mechanical processes to account for the vast out-turn of solar energy became seriously questioned after the discovery of radium. Later, spectroscopic evidence pointed to the existence of chemical compounds in the sun's atmosphere, and additional hypotheses were advanced. Dr. Briner agrees with Arrhenius regarding the inefficiency of radio-active changes, but shows that both endothermic and exothermic reactions involving either elementary or compound substances are likewise insufficient. Dr. Briner then proceeds to consider the thermo-chemical aspects of Sir Norman Lockyer's dissociation hypothesis, and concludes that if the interior of the sun is largely made up of matter in a proto-atomic state, it would constitute a respectable reservoir of energy capable of supplying a considerable portion of the solar radiation by the successive associations, resulting ultimately in the formation of the chemical elements.

THE SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES.

THE South-Eastern Union of Scientific Societies held its twenty-first annual congress at Tunbridge Wells on May 24–27, with the Rev. T. R. R. Stebbing in the presidential chair. Mr. Stebbing was president of the first congress held in the same town in 1896. Dr. Geo. Abbott, who was the chief founder of the union, was also present, and read a paper on "Some Remarkable Resemblances of Inorganic Formations to Organic." The president's address, which was, as he said, full of "thoughts that burn," took the unusual form of a comparison of Biblical records with scientific truth. Considerable feeling was elicited in discussion, and a proposal that the address should not be printed was defeated overwhelmingly. Mr. H. R. Knipe, in giving a paper on some extinct animals, showed a series of new slides made from remarkably lifelike drawings by Miss Alice M. Woodward. Dr. Keeble's paper on "Prehistoric Man" was illustrated by models of a lake-village, beehive Neolithic huts, etc., thus introducing an excellent method of educating an audience into the mysteries of human ancestry. Dr. P. Chalmers Mitchell lectured on the "Youth of Animals," and Mr. A. Archibald gave a valuable paper on the "Coinages and Mints of the South-Eastern District," illustrated by the asphingoscope.

In speaking on "Some Rarer British Birds," Miss E. L. Turner spoke of the reeve having been known to nest in England in 1907, and previously in 1897 and 1890, although now it is merely a migrant. Wholesale "egging," and the reclamation of land, were the causes of the extinction of the bittern in our country. The "boom" of the bittern was heard by a watcher in July, 1911, and by careful tracking the bird was found to be actually breeding. Miss Turner referred to the great crested grebe as a species which has largely benefited by the Bird Protection Acts. The curiously furtive habits of the water-rail were illustrated by a fine series of photographs, its shy habits making it a difficult bird to approach. Miss Turner undoubtedly scored a triumph when she found a pair of cormorants breeding in a disused heron's nest in Norfolk in July, 1914. This was the more remarkable in that there has been no record of nesting since 1825, and that in Suffolk. For upwards of 200 years Norfolk had lost the cormorant as a nesting bird. Sir T. Browne states that it built at Needham "upon trees, from where King Charles I. was wont to bee supplyed" ("MS. Notes and Letters, 1605–82," printed by T. Southwell, 1902). The nest which Miss Turner observed could only be reached by a 40-ft. ladder, and at this distance above the ground she exposed more than one hundred negatives. Some of these showed the playfulness of the young cormorants, and the insight gained into the habits of the nestlings is invaluable.

In a lecture by Prof. H. H. Turner, on "The Discovery of Oxygen in the Stars," the various steps by which the knowledge of this occurrence has been obtained were described. A paper which may prove of great educational importance was given in "Kosmos" Cinema Theatre by Dr. W. Martin on "The Educational Importance of the Cinema." It was pointed out how valuable a means of education is being lost in the neglect of this invention, and it was especially emphasised that by leaving picture-palaces severely alone the better classes were tending to allow the degradation of the type of film-pictures which are shown in them.

The congress met in very fine weather, and the excursions that were arranged met with success. Mention should be made of the visit to Lawson Wood's half-timbered house at Groombridge, which was removed from Udimore, near Winchelsea, where it was threatened with demolition. The remains of this fine old fourteenth-century court-house were thus saved from being treated as firewood.

BRITISH GEOLOGICAL SOCIETIES.

THE deep attraction which the study of the earth possesses for dwellers in our islands is shown by the existence of local geological societies, in addition to the numerous bodies devoted to natural history. While to many workers "the Geological Society" means that founded in London in 1807, and worthily commemorated in the "History" written by the late H. B. Woodward, we must remember that associations with similar objects exist in Edinburgh, Glasgow, Manchester, and Liverpool. The Geological Society of Dublin issued its first publication in 1838,

and its last in 1889, after it had become the Royal Geological Society of Ireland. There is no doubt that a knowledge of the aims of geology was more generally diffused in Ireland during the fifty years of its existence than is the case at the present day. Though the publication of researches outside London is naturally regretted by dwellers in the capital, a proper system of exchange and distribution after all renders reference easy. The index of geological literature, published annually by the Geological Society of London, now makes the place of publication unimportant. The recognition of other cities as centres of research requires a certain magnanimity, but is in itself a stimulus to cultured minds throughout the country. The claims, moreover, on the resources of metropolitan societies enable the publications of smaller bodies to compete successfully as regards style of issue and illustration.

The Edinburgh Geological Society has just published part 3 of volume x. of its Transactions. It contains a noteworthy and beautifully illustrated paper on the incorporation of dolomite in an intrusive basaltic sill at Gullane, near North Berwick, by T. Cuthbert Day, who also traces similarly intimate associations of igneous rock and sediments at Weak Law, where the composite mass resembles a fault-breccia or a conglomerate. Mrs. Wallace describes volcanic rocks from the necks along the coast of Fife, and points out the frequent occurrence of analcite. An international character is given to the Transactions by a paper by R. M. Craig on Prince Charles Foreland, Spitsbergen, the peaks of which are so conspicuous from the entrance to the Ice Fjord. A. McEwen Peach follows with an account of the pre-Glacial platform and raised beaches of the island (Fig. 1). The platform has the same relation to the submerged valleys as that discovered by Maufe and Wright in southern Ireland.

FIG. 1.—West coast of Prince Charles Foreland, showing the dissected "Backbone Ridge" and the coastal platform with raised beaches and lagoons. From the Transactions of the Edinburgh Geological Society.

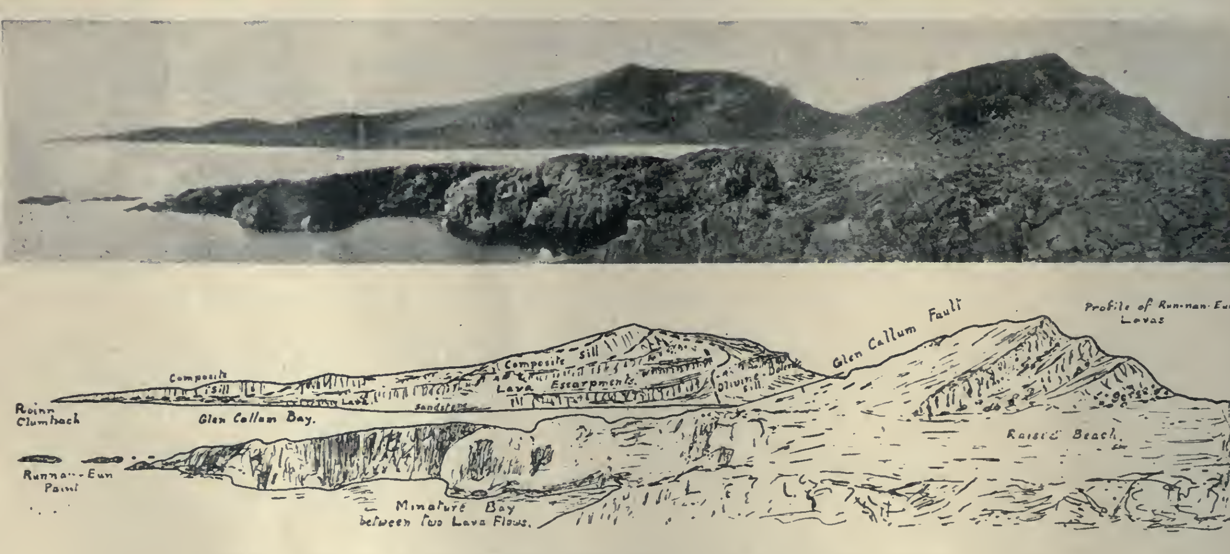

FIG. 2.—Panorama of South Bute, showing escarpments of lava uptilted towards the right, and a raised beach in the foreground. From the Transactions of the Geological Society of Glasgow.

The Geological Society of Glasgow, in part 3 of vol. xv. of its Transactions (1916), devotes itself to the basin of the Clyde. Prof. J. W. Gregory (p. 310) regards the hanging valleys on the walls of Loch Long as pre-Glacial in origin. W. R. Smellie describes in detail the igneous rocks of Bute, after a field-survey of the island (Fig. 2). P. Macnair correlates the Lower Carboniferous limestones of North Lanarkshire with those farther to the south, in a paper that reveals characteristically patient research in river-banks and quarries.

The Liverpool Geological Society continues to investigate the Triassic strata of the district. In part 2 of vol. xii. of the Proceedings (1915), this work is represented by F. T. Maidwell, H. W. Greenwood, and C. B. Travis. There is an interesting reference in a paper by the two latter authors to "boulders of strontium" in the Keuper Marls of Bristol. These are pre-

sumably celestine, like the well-known examples from Aust, which were mentioned by Wm. Phillips as far back as 1816. H. Bolton and C. J. Waterfall have described the occurrence at Abbots Leigh as "strontia." Messrs. Greenwood and Travis indicate the presence of secondary, as well as primary, rutile in the Triassic rocks of Wirral. The former author, in a paper on the paragenesis of marcasite, wurtzite, and calcite at Halkyn Mountain, North Wales, concludes that, while the two former minerals arise from acid solutions (see NATURE, vol. xciv., p. 430), a higher temperature or a greater concentration of acid is required for the production of wurtzite than is required for marcasite. In the Halkyn case the acid present was the carbonic acid that simultaneously gave rise to calcite. Zincblende here predominates largely over wurtzite, while more than 90 per cent. of the iron disulphide is present in the form of marcasite.

The same society also issues a part entitled the Cope Memorial Volume, presented to geologists in this form by the generosity of Mrs. T. H. Cope, and embodying the researches of her late husband on the igneous rocks of the Berwyn Hills. G. A. J. C.

THE "RUSSIAN ZOOLOGICAL REVIEW."

WE have received the first number of a new Russian journal, of which the French title is given as *Revue Zoologique Russe*. It is published at Moscow, under the editorship of Prof. A. N. Sewertzoff and W. S. Elpatiewsky, of the Moscow University. The intention of the editors is to publish preliminary notes and short articles on zoology, comparative anatomy, histology, and embryology, together with abstracts, personalia, and a zoological bibliography. The text is to be either in Russian with a French or English *résumé*, or in French or English with a Russian *résumé*.

The contents of this first number show that the editors aim at a high standard of work. One of the most interesting contributions is an account of some important experiments by D. Filatoff on the removal and transplantation of the auditory vesicle of the embryo toad. It has been known for some years that the optic vesicle of certain embryos can be transplanted, and that the presence of such transplanted vesicles determines the development of a lens from the epiblast in abnormal situations. M. Filatoff claims to have established analogous facts with regard to the auditory vesicles. He maintains that the presence of the auditory vesicle, even in an abnormal situation, determines the formation of a cartilaginous auditory capsule from the surrounding mesenchyme cells, which would not normally give rise to such a structure. Unfortunately for English readers, the original article is published in Russian, and the English abstract is scarcely detailed enough to afford convincing proof that the author has established his point with regard to the development of the auditory capsule. That an auditory capsule does actually develop around the transplanted vesicle there seems to be no doubt, but, as the author himself suggests, it seems to be possible that it may develop from mesenchyme cells transplanted with the auditory vesicle, and this is the point which we should like to see more satisfactorily cleared up, though we agree that the probabilities are in favour of the contention that it arises from the surrounding mesenchyme of the new locus.

We regret to note in this article the oft-repeated use of the German word "Anlage," which seems to have established itself permanently as an essential part of embryological terminology. Why it should have done so we have never been able to understand, for the term "rudiment" seems to meet all requirements in a perfectly satisfactory manner. It is true that this term used to be very loosely employed by English writers, and was at one time very generally applied to disappearing structures. The much more appropriate term "vestige" has, however, now been very generally accepted for structures belonging to the latter category, and all possible objection to the use of the term "rudiment" for the first recognisable indication of a developing organ seems to have disappeared. Not long ago it was customary on the part of certain English zoologists to use the German term "Haus" for the enveloping test of certain Ascidians. The inappropriateness of the English word "house" was perhaps recognised by these writers, but did it really improve matters very much to adopt the German form of the same word? Even since the commencement of the war we have seen, in a newspaper, the term "under-sea boat"—an obvious adoption from the German—used in place of our own "submarine." It is little wonder, when we show ourselves so slavishly dependent upon German phraseology, that the impression should have been created that in scientific matters our German antagonists are a long way ahead of us.

This digression, however, has taken us a long way from the *Revue Zoologique Russe*, to which we wish to extend a hearty welcome, and our best wishes for a long and useful career. It says much for the confidence and sanity of our great Allies that they are able at such a time as this to devote their attention to researches in pure science and even to find funds for the publication of new journals. They have set an example which those of us who are unable to take any active share in the prosecution of the war need not be ashamed to follow. A. D.

THE WATER SUPPLY OF MELBOURNE.

RECENT issues of the *Engineer* (April 7 and May 5) contain an extremely interesting *résumé* of the inception and gradual development of the water supply system of the city of Melbourne. As is customary in the case of primitive settlements, the earliest supplies were derived from the local river, the Yarra, and until about the middle of last century this simple, although scarcely altogether satisfactory, expedient sufficed for the needs of the inhabitants. In 1853, the first steps were taken to secure a more trustworthy and less contaminated supply from the watershed at Mount Disappointment. This was achieved by the formation of an embankment at Yan Yean. The undertaking, which was completed in 1857, at a cost of 754,206*l.*, was considered to be capable of providing a population of 200,000 with water at the rate of 30 gallons per head per day; as a matter of fact, it considerably exceeded this expectation. The dam, which was of earth, was 30 ft. in height, and formed a lake of 1360 acres, with a water capacity of 6400 million gallons, of which 5400 million gallons were available for consumption.

By the year 1879 it became evident that additional gathering ground was necessary to meet the demands of a population now grown to 256,000, with a consumption of 80 to 90 gallons per head per day. After some search, a suitable extension of the existing system was devised to Wallaby Creek, on the north side of Mount Disappointment. The Wallaby Aqueduct was constructed in 1883, $5\frac{1}{4}$ miles long, with a carrying capacity of 33 million gallons, together with the Toorourrong Reservoir, holding up 60 million gallons of water, and forming a lake of 36 acres surface.

The city continued to expand, and, in process of time, the Yan Yean system was fully exploited and

incapable of further development. In anticipation of this exhaustion, in 1880, a scheme had been prepared for tapping the Watts River, the average daily flow of which was estimated at 42 million gallons. The execution of the project was, however, delayed, and it was not until 1891 that water from this source was actually turned on, when the name of the system, as well as of the river itself, was changed into Maroondah. The aqueduct is 41 miles long, with $25\frac{1}{2}$ miles of open channel and twelve tunnels (three over a mile in length). The total cost of the Maroondah system amounted to 778,944*l*.

By 1907 the population had increased to 536,540, and still further sources of supply were found necessary. In 1910, powers were granted to incorporate the O'Shannassy and Upper Yarra watersheds, and by 1914 a supply of 20 million gallons per day was being obtained from the former river by means of an aqueduct $48\frac{3}{4}$ miles in length. The Upper Yarra supplies remain to be exploited at some future date. The amount spent so far on the O'Shannassy scheme has been 426,890*l*.

THE MECHANISM OF CHEMICAL CHANGE IN LIVING ORGANISMS.[1]

If we take a general view over the large field of chemical reactions known, we notice that there is a great variety in the *rate* at which these reactions take place. Some, and especially those in which electrical forces play a part, reactions between inorganic ions, are practically instantaneous. They are familiar to all in the precipitations of the analytical chemist. Others, such as the hydrolysis of cane-sugar by water, are so slow as to be incapable of detection at ordinary temperatures, unless a very long time is allowed. There are, moreover, all possible stages intermediate between these extremes. Reactions between carbon compounds are, generally speaking, comparatively slow; but, as the name "organic" indicates, they are the characteristic chemical changes of the living cell.

Early workers in the domain of physiological chemistry—Schönbein, for example—were struck by the fact that reactions which require, in the laboratory, powerful reagents, such as strong acids and high temperatures, to make them take place at a reasonable rate, occur rapidly in the living organism at moderate temperatures and in the presence of extremely weak acids or alkalis. I may refer to the decomposition of proteins into their constituent amino-acids, which is a part of the normal process of digestion, but, when ordinary laboratory methods are used, requires boiling for several hours with concentrated hydrochloric or sulphuric acid.

The problem before us, then, is to discover how a slow reaction can be made to go faster. The most obvious and well-known method of doing this is by raising the temperature; but this is clearly out of the question in living cells. Another possibility is to make use of mass action, increasing by some means the effective concentration of the reacting substances; in this way the number of contacts per unit time would be raised. This is possible in the cell. There remains a third, the formation of an intermediate compound with another substance. This compound may be supposed to be both formed and again decomposed at a rapid rate, so that the total time taken is much less than that of the original reaction.

Now it is evident that something of the kind contemplated by these two latter possibilities is at the bottom of the process called "catalysis" by Berzelius. This chemist directed attention to the numerous cases known, even at his time, where the presence of a third substance brings about an enormous acceleration of a reaction, without itself taking part in it, so far as appears at first sight; at all events, this third substance reappears at the end unchanged. An example is the effect of finely divided platinum on hydrogen peroxide. Similar phenomena were known to Faraday, and described by him about the same time, but without giving them a special name.

Agents of this kind were soon discovered to be present in living cells. Such catalysts are called, for convenience, "enzymes," as suggested by Kühne, although there is no real scientific necessity for the name. That of "ferments" is still sometimes used, and is not now liable, as it was in Kühne's time, to cause confusion by application to living microbes.

Since catalysts are, as a rule, found unchanged at the end of their work, it is clear that they do not themselves afford energy for the purpose. Indeed, the energy change of a catalysed homogeneous system is the same as that of the reaction when proceeding at its ordinary slow rate. How, then, do they act?

The first thing to note with respect to enzymes is that they are capable of activity in media in which they are insoluble. Whatever may be the nature of this activity, therefore, it is exerted by the surface of the catalyst. We may then reasonably ask, as the most obvious hypothesis, is there ground for holding that the increased rate of reactions brought about by enzymes is effected by increase of concentration of the reagents at the surface and consequent acceleration of the reaction by mass action? We know that substances which lower surface energy of any form are concentrated at such boundary surfaces. The process is well known as "adsorption," and is a consequence of the operation of the principle of Carnot and Clausius, which states that decrease of free energy always occurs, if it is possible for it to do so. In fact, such an explanation was given by Faraday of the effect of metallic platinum in causing combination of oxygen and hydrogen gases. Although the name "adsorption" was not used in this description, Faraday had very clear ideas of the process, and gives several interesting cases. He showed that the necessary condition for the activity of platinum in the case referred to is a chemically clean surface, in order that the gases may condense on it. It matters not whether the removal of deposit is effected by mechanical polishing; by the action of acid or of alkali; by oxidation or reduction—making it either anode or kathode in an electrolytic cell will serve. It should be mentioned that this view did not receive universal acceptance, but the fact that it recommended itself to the keen insight of Faraday is powerful evidence in its favour.

I would not venture to state that this hypothesis is yet in a position to explain all the facts met with in the action of enzymes themselves, but it is remarkable how many receive a satisfactory account. We are at once confronted by the difficulty of the considerable number of different enzymes. But we must not forget that adsorption is controlled by a great number of factors in addition to mechanical surface tension. All those properties which suffer modification at phase boundaries play their part—electrical charge, solubility, compressibility, even chemical reaction itself, may be mentioned. Moreover, as Hardy has pointed out, the act of condensation in itself may well be accompanied by the manifestation of molecular forces which result in increased chemical potential of the reacting substances. It is clear that experimental decision of the questions involved is almost impossible until we have in our hands pure preparations of enzymes. We cannot as yet exclude the possibility of the formation of intermediate *chemical* compounds

[1] Abridged from a discourse delivered at the Royal Institution on March 24, by Prof. W. M. Bayliss, F.R.S.

between enzyme and substrate, but their existence has not been demonstrated, and what I may venture to call Faraday's view has the advantage of simplicity, and thus the support of William of Occam's "razor."

The important question of the synthetic action of enzymes demands a little attention at this point. All reactions may be regarded as being, in principle, reversible or balanced, and the greater part of those of the living organism are found experimentally to be so. If we take for consideration those enzymes the action of which consists in the addition or removal of the elements of water, we find that, as would be expected from the law of mass action, the position of equilibrium in the presence of a large excess of water is very near to that of complete hydrolysis, and this is the state of affairs in the usual laboratory experiments. On the other hand, the less water is present, the greater is the preponderance of the opposite—synthetic—aspect. Take the classical case of ethyl acetate. If the ester and water are mixed in molecular proportions, hydrolysis to acid and alcohol occurs until two-thirds of the ester are decomposed. Moreover, the same final composition is obtained if we commence with acid and alcohol, and so work in the other direction. But these reactions proceed by themselves with extreme slowness, taking months before coming to an end. But the presence of a catalyst, such as mineral acid, brings about equilibrium in an hour or so, and we notice that it is the same as the spontaneous one. An enzyme, known as lipase, also brings about equilibrium rapidly. The important point in respect of the mechanism of living cells is that by changing the available amount of water, the reaction may be made to proceed in either direction at will. The series of curves given by Armstrong and Gosney (Proc. Roy Soc., 88 B, p. 176) show this fact very clearly. Further, if the equilibrium is brought about rapidly, even if to any position except that of complete change in one or the other direction, the enzyme must accelerate *both* reactions, and any hypothesis of special "synthesising" enzymes is superfluous. This is essentially the position taken by van't Hoff in the work with which he was engaged at the time of his death. What is required, then, is a means by which the cell is enabled to change the available water at the disposal of reactions occurring therein. We do not as yet know the precise nature of such mechanisms, but there is reason to believe that they are provided by changes in the surface area of colloidal constituents or in the power of imbibition possessed by certain contents of the cell.

We here come across an interesting problem which cannot be said to be solved satisfactorily at present. We have seen that the equilibrium position of an ester system when reached rapidly under the action of a soluble catalyst is the same as the spontaneous one. But there is a certain difference when a heterogeneous catalyst, or enzyme, is used. Nevertheless, the equilibrium is a true one, being in the same position when approached from either end. The amount of butyric acid combined as amyl ester in a particular system under acid catalysis was found by Dietz to be 88 per cent. of the total; under the action of the enzyme lipase it was only 75 per cent. This fact has given rise to various suggestions, and has troubled people's minds because it appears to give a possibility of evading the second law of energetics. Now, it was pointed out to me by Prof. Hopkins that, on the hypothesis of a rapid attainment of equilibrium by condensation on the surface of the enzyme, it is necessary, if the natural equilibrium is to be unaltered, that adsorption of all the components of the system should be the same proportion of each, because the position of equilibrium must be the same on the surface of the enzyme as that which results in the body of the solution. In the presence of a large excess of water, it does not seem likely that a difference of equilibrium owing to this cause could be detected. But this should be possible when the equilibrium position is nearer the middle, so to speak, and I am at present engaged in experiments on the question. At any rate, difference in adsorption may be the cause of the phenomenon of Dietz. It would simply imply that water is adsorbed by the enzyme in relatively larger proportion than the other constituents of the system. It should be remembered that the solvent in these experiments was amyl alcohol containing about 8 per cent. of water, and, as Arrhenius has shown, all substances present are adsorbed, although the laws governing the relative proportion of these various substances are not yet completely worked out.

We see, by consideration of the facts relating to the action of enzymes, how important a part is played by changes in the rate of reactions, and there are two further points to which attention has been directed by Prof. Hopkins. Take, first, a series of reversible reactions in which the products of one form the starting point of the next following:—

$$A \rightleftharpoons B \rightleftharpoons C \rightleftharpoons D \rightleftharpoons \text{ etc.}$$

If the rate at which B is converted into C is greater than that at which A changes into B, it is obvious that the amount of B present at any moment may be extremely small, although the whole of the final products have passed through the stage. The fact warns us from estimating the importance of any particular constituent of the cell by the quantity to be obtained.

The second point is this. Suppose that there are two independent reversible reactions, both leading to the same product, C.

$$\begin{tikzcd} A \arrow[dr, shift left] & \\ & C \arrow[ul, shift left] \arrow[dl, shift left] \\ B \arrow[ur, shift left] & \end{tikzcd}$$

and that $A \longrightarrow C$ is more rapid or easier than $B \longrightarrow C$. This latter reaction will be practically absent, being balanced by the excess of C. But, if the former reaction is abolished by removal of A, then $B \longrightarrow C$ will take place in proportion as C is used up in other reactions. Thus, under special conditions, a reaction may take place which is not detectable under normal conditions, although capable of taking place.

One of the most difficult questions is the manner in which the various components of the cell are prevented from entering into chemical reaction except when required. Enzymes, for example, are not always in activity. The conception which states that the cell consists of numerous minute "reaction chambers," separated from one another by membranes, seems to present most possibilities. These membranes must be regarded as capable of removal and of reconstruction, or reversible as regards their permeability. The food vacuoles of an Amœba may serve as an illustration of such chambers on a comparatively large scale. In these vacuoles digestion processes are going on independently of other reactions in various parts of the same cell protoplasm, although this latter behaves as a liquid.

The general conclusion to which we arrive is that velocity of reaction plays an exceedingly important part in the regulation of cell mechanics. I venture to think that the conception is destined to replace static points of view, such as that of "lock and key" or the fitting together of molecular groupings. That there is still very much to be discovered is obvious. We have to find out how the living cell is able to modify and adjust together the large number of reactions known to the chemist. The study of the methods by which the rate of these reactions is affected is one of the most valuable of those accessible to us.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IN "A Forgotten Chapter in the History of Education," referring especially to the important report of the Consultative Committee on Examinations in Secondary Schools, issued in 1911, Mr. J. S. Thornton pleads earnestly the case of the College of Preceptors, a union essentially of the private schools, as the originator and sustainer of a system of leaving examinations which has not only been the inspirer of the Local Examinations instituted by the Universities of Oxford and Cambridge, but has also helped materially in making them efficient. To quote his own words, the College "was the poor inventor; the Universities, by their capital and prestige, have worked the invention for all it is worth. College and University have done together what neither of them could have done separately." So he urges that, rather than set up some other system, the State should more fully utilise the services of both bodies. But Mr. Thornton's pamphlet is much more than an apologia of the College of Preceptors; it is really a fervent plea for the full recognition by the State of the private schoolmaster and the private school, even to the extent of adequate financial aid. In support of such a policy he adduces the example of Scandinavian countries, and claims that the extraordinary success it has achieved from the point of view of efficiency, fruitfulness of suggestion, freedom of experiment, excellence of results, and economy in working fully warrants the closest investigation with a view to the recognition by the State under conditions of educational freedom of every kind of efficient and needed school.

SEVERAL important points relating to university education in the United States, Germany, and the United Kingdom are referred to in the *Observer* of June 18, in an interview which a representative of our contemporary had with Mr. Alfred Noyes, who has just returned to this country, after occupying the chair of English literature at Princeton. Mr. Noyes points out that a large proportion of the staffs of the colleges and universities in the United States received all its educational training, or at any rate its post-graduate training, in Germany. Americans have been encouraged to go to Germany and to pass from one university to another to take whatever courses they desire, but no facilities of this kind have been offered them here. It must, however, be remembered that, in addition to providing opportunities for intensive or extensive study, English-speaking students—whether American or British—have, by going to Germany, had the advantage of acquiring the use of the German language. This fact has no doubt often induced American students to take post-graduate courses in German, instead of British, universities. Mr. Noyes says:—"I am told by Americans that in many cases when they want to come to English universities to do post-graduate work they must begin all over again, and that the work they have done for their American degrees will not be allowed to count." We believe, however, that this is not now the case, and that post-graduate students are welcomed at most of our universities. Mr. Noyes refers to the large number of students in American universities, and we are able to supplement his remarks with figures showing—to the nearest hundred—the enrolment for 1915 in thirty institutions, excluding summer-session students:—Columbia, 7000; Pennsylvania, 6600; California, 6000; New York University, 5900; Michigan, 5900; Illinois, 5500; Harvard, 5400; Cornell, 5400; Ohio State, 4900; Wisconsin, 4900; Minnesota, 4700; Chicago, 4300; North-western, 4100; Syracuse, 3800; Pittsburgh, 3600; Yale, 3300; Nebraska, 3100; Missouri, 3000; Iowa State, 2700; Texas, 2600; Cincinnati, 2500; Kansas, 2500; Stanford, 2000; Indiana, 1800; Princeton, 1600; Western Reserve, 1500; Tulane, 1300; Washington University, 1300; Johns Hopkins, 1200; Virginia, 1000.

THE confidence of the German nation in the value of education and in its uplifting and recuperative power, even in face of a disastrous termination to the present struggle, is strikingly illustrated by the following extract, which appeared in the *Schoolmaster* for June 17, taken from *Der Tag*, a paper established some years ago with the view of promoting German naval supremacy. "We Germans," it said, "can proudly point to the fact that our expenditure on the education of our children has been fully maintained during the war at its former level. In Prussia and elsewhere it has even, for certain objects, been increased. But the money-making, so-called democratic England finds it necessary to cut down her education bill to the lowest limit. We rejoice at the fact that our enemies are discouraging the education and instruction of the masses. By the mere fact that British children are being deprived of education we have a great victory over England, for after the war, more than ever before, will knowledge and education, organisation and adaptability on the part of all classes of the population bring victory in the economic struggle." The leaders of the nation look forward with triumphant anticipation to the resumption of the economic struggle after the close of the war, and are intent upon preserving and enhancing the educational means and methods which have given them victory in the past. We, on the other hand, both Imperially and locally, have entered upon a policy of educational starvation: urgent building operations are suspended, equipment is curtailed, school buildings are commandeered and school hours reduced, secondary-school fees are raised, scholarships are reduced in value or are suspended, evening classes are in large measure closed, and school children allowed to leave school at a much earlier age. It is not for want of means—witness the enormous profits made as a result of the war as appears from a statement in the *Manchester Guardian* of June 19, wherein appeared a list of 154 firms engaged in shipping, coal, iron, engineering, tea, rubber, and other industries which showed a gross and net profit for 1916 exceeding by thirteen millions sterling those for 1914; and our direct expenditure upon drink exceeds 180 millions annually—but lack of vision and indifference to the value and potency of education. We need to raise the status of the Board of Education and give it the rank of a department of the State, so that it will attract to its direction men of the highest intelligence and zeal. Education is at least as vital to the well-being of the nation as any other of the great services under the Crown. Whilst leaving a desirable liberty of interpretation according to local conditions, it should at least make mandatory upon all local authorities the duty of providing completely and adequately for all forms of education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 8.—Sir J. J. Thomson, president, in the chair.—The Earl of **Berkeley** and E. G. J. **Hartley**: Further determinations of direct osmotic pressures. In this communication the osmotic pressures of the following substances are measured directly:—Cane-sugar and methyl glucoside, a number of ferro- and ferri-cyanides, and one or two other salts. The cane-sugar determinations were made on a

somewhat purer sugar than was the case in the previous work; the results extend over the range already covered by Prof. Morse and his co-workers, and the two sets of numbers are found to differ slightly at the lower concentrations. For the ionised substances examined it may be stated that, with the exception of one salt, all those having a molecule made up of a dyad base combined with a dyad acid radicle are associated in aqueous solution. The "dynamic" method of measuring osmotic pressures is developed so as to afford a means of rapidly estimating molecular weights to a considerable degree of accuracy even in very dilute solution.—Prof. E. **Wilson** and Prof. J. W. **Nicholson**: The magnetic shielding of large spaces and its experimental measurement. (1) The magnetic shielding of a large space is a problem wholly different in practice from that of a small space, and in view of important applications the efficiency to which much shielding can be raised is a matter of importance. Considerations of mobility of the apparatus and weight of iron required necessitate the solution of the problem of maximum shielding for a given weight of iron and more than two shells, together with an examination of the limitations of utility of lamination. These problems are discussed in the paper. (2) A field of order as low as 3×10^{-3} has been obtained in a space of radius 30 cm. by the use of 1273 kilos (2806 lb.) of high-permeability dynamo magnetic steel, and an accurate method designed for the measurement of fields of lower order. (3) The leakage through air spaces in a magnetic shield has been studied. (4) It is now possible to examine the behaviour of iron under practically no magnetic force.—G. I. **Taylor**: Motion of solids and fluids when the flow is not irrotational. The paper deals with the motion of solids in rotationally moving fluids, a problem which has not apparently engaged the attention of mathematicians before. The motion of cylindrical solids in rotating fluids is discussed, and it is shown that a solid cylinder of the same density as the fluid will move through a rotating fluid exactly as if the fluid were not rotating. On the other hand, a solid sphere of the same density as the fluid will be deflected to the right if the fluid is rotating anti-clockwise, and to the left if it is rotating clockwise. This property of rotating fluids is demonstrated experimentally by means of experiments performed with a rotating tank full of water. It is shown experimentally that vortex rings move in circles through a rotating fluid.

Mathematical Society, June 8.—Sir J. Larmor, president, in the chair.—Prof. M. J. M. **Hill**: The classification of the integrals of a linear partial differential equation of the first order.—Prof. W. H. **Young**: (1) Non-absolutely convergent, not necessarily continuous, integrals. (2) The convergence of Fourier series and of their derived series.—Dr. S. **Brodetsky**: The general linear differential equation.—A. E. **Jolliffe**: A note on the series $\Sigma a_n \sin n\theta$ and $\Sigma a_n \cos n\theta$, where (a_n) is a sequence of positive numbers tending steadily to zero.—T. C. **Lewis**: Circles connected with "four Tucker circles."—F. J. W. **Whipple**: A symmetrical relation between Legendre's functions with parameters cosh α and coth α.—H. T. J. **Norton**: A problem in Diophantine approximation.

CAMBRIDGE.

Philosophical Society, May 22.—Prof. Newall, president, in the chair.—Dr. **Willis**: Some considerations on the geographical distribution of species. In some recent papers it has been sought to show that the dispersal of species (so long as no barriers intervene) depends simply upon their age within the country concerned, and is independent of natural selection. A general account was given of the results so far obtained by a study of the floras of Ceylon and New Zealand.—C. P. **Dutt**: A preliminary note on the internal structure of *Pityostrobus* (*Pinites*) *macrocephalus* from the Lower Eocene. A brief description is given of the general anatomy of two forms of cone from the Lower Eocene of the London basin, attention being drawn to certain unrecorded or characteristic features. The structure of the seeds is described for the first time, and the presence of fossil embryos is recorded. Pollen grains are found occurring at the apex of a peculiar nucellar column. Evidence is given that the two forms are specifically identical, and are related to an existing species, *Pinus excelsa*.

EDINBURGH.

Royal Society, May 15.—Dr. J. Horne, president, in the chair.—Dr. D. **Ellis**: The Jurassic fossil fungus, *Phycomycites Frodinghamii*, Ellis. The paper brings forward fresh evidence of the true biological nature of this fossil fungus, found by the author in the Frodingham Ironstone of Lincolnshire. It is the first recorded instance of fossil fungi from Jurassic rocks. The probable reason for its preservation was the absorption within the organism of iron from the surrounding water. The members thus became impregnated with ferric oxide, as in the case of modern iron-bacteria. The most significant feature is that the fossil threads show the same variations in nature of membrane as in these bacteria. Although no traces were found of the cellular tissues of the animal host in the Frodingham Ironstone, such traces were found in combination with fungal threads in the Dunliath ferruginous limestone. It is interesting to note that this fossil fungus was found in a marine deposit.—Dr. R. A. **Houstoun**: A possible explanation of the satellites of spectral lines. Many bright lines in the spectra of gases are accompanied by fainter lines known as satellites. The usual way of regarding these is to consider them as due to independent electrons or degrees of freedom in the molecule. The view presented in this paper and worked out mathematically was that they might be regarded as due to the same degree of freedom as the main line, being caused merely by the manner in which the vibrations are started or stopped.

PARIS.

Academy of Sciences, June 5.—M. Camille Jordan in the chair.—H. **Le Chatelier**: The devitrification of glass (*cristal*). Devitrification has hitherto been noticed only in glasses containing lime and calcium monosilicate, $CaSiO_3$ separating out. Details are given of a case of devitrification in a lead glass. The separated crystals in this case were found to be tridymite, and this is the first example of a crystallisation of silica in the devitrification of a glass.—A. **Chauveau**: Dr. Lucien Jacquet and tuberculosis in the employés in Parisian wine-bars. Important hygienic consequences of the new facts obtained in this study.—A. **Blondel** and J. **Rey**: The comparison, from the point of view of range, of short light signals produced by a rotating apparatus, by sources of light giving different periods of impression. The conditions of maximum efficacity of the light flux utilised. The experiments described prove that in the utilisation of a source of light for the production of light flashes succeeding each other at fixed intervals, and produced by the rotation of an optical apparatus, it is better that the flashes should be as short as possible.—A. **Denjoy**: Certain classes of functions of real variables.—M. **Fréchet**: The equivalence of two fundamental properties of linear ensembles.—G. **Hall-Hamilton**: Study of the planet Mars at the Flagstaff Observatory, Arizona. A map of the markings on the planet is given. The atmosphere proved to be exceptionally favourable for

these observations.—C. V. L. **Charlier**: The construction of the galaxy. Charts are given showing the projections of the group of stars of spectral class B (helium stars) in three directions.—A. **Pictet** and P. **Stehelin**: The formation of pyridine bases by condensation of ketones and amides. Following the analogy of the formation of mesitylene, an attempt was made to prepare pyridine by the condensation of acetone and acetamide. The experiment failed with the usual dehydrating reagents, but pyridine (2 to 3 per cent. yield) was obtained by heating in sealed tubes to 250° C.—B. **Galitzine**: The localisation of the epicentre of an earthquake from observations at a single seismic station.—L. **Eblé**: The deviations from the vertical at Paris.—J. **Cardot**: The bryological flora of Kerguelen. This flora presents close analogies with that of South Georgia.—MM. **Neveu-Lemaire, Debeyre,** and **Rouvière**: A prolonged form of cerebro-spinal meningitis and cerebral trepanning. A description of a case in which the injection of antimeningococcic serum into the right lateral ventricle was resorted to, resulting in a complete cure.—F. **Bordas**: Ozonised oxygen in the treatment of war wounds. The wounds are kept in an atmosphere of ozonised oxygen, without dressings, and exposed to solar radiation. The results have been particularly satisfactory in large wounds where the tissues had been invaded more or less deeply by septic products and anaerobic fermentations. The treatment can be prolonged without inconvenience to the patient, and the general appearance of the wounds rapidly improves, the fetid smells disappearing at the very commencement.—J. **Amar**: The sense education and utilisation of mutilated limbs.

BOOKS RECEIVED.

Milk and its Hygienic Relations. By Dr. J. E. Lane-Claypon. Pp. viii+348. (London: Longmans and Co.) 7*s.* 6*d.* net.

The Cruise of the *Tomas Barrera.* By J. B. Henderson. Pp. ix+320. (New York and London: G. P. Putnam's Sons.) 12*s.* 6*d.* net.

Proceedings of the South London Entomological and Natural History Society, 1915–16. Pp. xv+156. (London: Hibernia Chambers.) 5*s.*

Exercices Numériques et Graphiques de Mathématiques sur les leçons de Mathématiques générales du même auteur. By Prof. L. Zoretti. Pp. xv+124. (Paris: Gauthier-Villars et Cie.) 7 francs.

Leçons sur le Fonctionnement des Groupes Electrogènes en Régime Troublé. By Prof. L. Barbillion. Pp. ii+306. (Paris: Gauthier-Villars et Cie.) 11 francs.

Sex-Linked Inheritance in Drosophila. By T. H. Morgan and C. B. Bridges. Pp. 87+plates ii. (Washington: Carnegie Institution.)

Guide to the Materials for American History in Swiss and Austrian Archives. By Prof. A. B. Faust. Pp. x+299. (Washington: Carnegie Institution.)

On the Manufacture and Testing of Prismatic Compasses, especially Mark VII., Military Pattern. By F. E. Smith. Pp. 48. (London: Optical Society.)

My Yoruba Alphabet. By R. E. Dennett. Pp. xi+45. (London: Macmillan and Co., Ltd.) 1*s.* 6*d.* net.

Man—an Adaptive Mechanism. By Prof. G. W. Crile. Pp. xvi+387. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

The Military Map. Elements of Modern Topography (French School of War). Pp. vii+130. (London: Macmillan and Co., Ltd.) 2*s.* 6*d.* net.

Some Recent Researches in Plant Physiology. By Dr. W. R. G. Atkins. Pp. xi+328. (London: Whittaker and Co.) 7*s.* 6*d.* net.

Discovery: or, The Spirit and Service of Science. By R. A. Gregory. Pp. x+340. (London: Macmillan and Co., Ltd.) 5*s.* net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 22.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: Evolution and Symmetry in the Order of the Sea-pens: Prof. S. J. Hickson.

WEDNESDAY, JUNE 28.

GEOLOGICAL SOCIETY, at 5.30.—A New Species of Edestus from the Lower Carboniferous of Yorkshire: Dr. A. Smith Woodward.—The Tertiary Volcanic Rocks of Mozambique: A. Holmes.

THURSDAY, JUNE 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Genesis of Pleochroic Haloes: Prof. J. Joly.—Some Determinations of the Sign and Magnitude of Electric Discharges in Lightning Flashes: C. T. R. Wilson.—Further Observations on Protozoa in relation to Soil Bacteria Dr. T. Goodey.—New Bennettitean Cones from the British Cretaceous: Dr. M. C. Stopes.—And other Papers.

ROYAL SOCIETY OF ARTS, at 4.30.—The Sikhs: Sirdar Daljit Singh.

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THURSDAY, JUNE 29, 1916.

RESEARCH IN INDUSTRY AND THE FUTURE OF EDUCATION.

THE demand for a drastic review of the whole of our educational policy and methods, having regard to the results, grows apace. The events of the war have served to reveal in startling fashion our shortcomings in production, especially in the domain of the applied sciences, and notably in the extent to which, by reason of our neglect to train adequately those engaged in scientific industries, we have found ourselves almost slavishly dependent upon our chief industrial and commercial rival—with whom, alas! we are now engaged in deadly strife—for some of the most vital necessities of our industries. Of this regrettable fact the great textile industries of Lancashire and Yorkshire (so large a proportion of which are engaged in manufacture for export), many important departments of chemical and engineering enterprise, the manufacture of chemical and optical glass and endless other productions of service in medicine and in the arts of life, not to speak of the grave difficulties with which we have been confronted in the supply of high explosives, furnish abundant evidence.

Could it be shown that this failure on our part arises from some special advantages of climate or of natural resources possessed by Germany, it might be accepted as in the order of Nature and as a satisfactory, though regrettable, explanation, but the very reverse is the case; nor is it to be found in any lack of intellectual ability in the English child. The real solution is to be found in the more effective provision for the education of all classes, such as that prevailing in Germany, whether of the rank and file or of those intended to be the directors of industry or of commerce. Hence the provision in Germany of (1) a complete system of elementary education applying without compromise to the children of the industrial class up to the close of their thirteenth year and continued under specialised conditions, within the normal working time, for at least six to eight hours per week in continuation schools until the age of eighteen is reached; we, on the contrary, allow some two and a quarter millions of our youth between the ages of twelve and eighteen to cease entirely their attendance at school; (2) ample facilities for all forms of secondary education, covering, from the tenth year, six or nine years, and leading up, so far as the higher schools are concerned, direct to the universities and technical high schools, with a preparation on the part of the matriculated students far in excess of that which, generally speaking, obtains with us, since the average length of secondary-school life in England does not exceed three years. These facilities for general education are crowned by magnificent provision for scientific training in the universities and technical high schools, not to mention numerous special schools dealing exclusively with mining, agriculture, forestry, or with the textile or other industries.

The easy optimism of some of the speakers at the recent conference of the British Imperial Council of Commerce is somewhat disturbing in view of the actual facts as to the students in attendance at German technical high schools, excluding those in the universities, as compared with those in all British institutions.

It may be admitted at once that since 1902 there has been a great and gratifying increase in the number and efficiency of the institutions in Great Britain giving scientific and technical training, and in the number of students participating therein, but so, too, has been the advance in Germany. A useful and striking comparison may be found in the statistics collected by the Association of Technical Institutions in 1902. Information was obtained from *ninety-nine* institutions in the United Kingdom, including all the universities, as to the number of day students of *fifteen* years of age and upwards engaged in scientific and technical studies, no matter what their character, and the figures supplied were compared with those obtained from *nine* German technical high schools, with results absolutely startling in their significance. In no case were the students in the German schools less than eighteen years of age, whilst of these almost the entire number presented certificates of attendance on a nine years' classical or modern course, and their ranges of study were confined in the main to civil and naval architecture, engineering and chemical subjects. The total number of such students was 12,422, whilst the immatriculated students numbered 3020, or a total of 15,442, including a large body of foreign students.

Contrast this with figures relating to the *ninety-nine* British institutions, including the universities (the German universities were not included), which showed 3873 enrolled of fifteen years of age and upwards taking many subjects not included in the German return. Of this number 2259 took engineering and 667 chemistry, including dyeing and metallurgy. The number of third-year matriculated students in the nine German schools was 2021, in all the English institutions 535; in the fourth year it was 1800 and 113 respectively (in the Charlottenburg school *alone* there were 477 third- and fourth-year students). To seek another comparison, there were in the

Massachusetts Institute of Technology in 1902 more than 1100 students of the average age of 18·2. It is childish to talk of "enemy students in British schools" when in one German technical high school alone, that of Karlsruhe, there were in 1902 283 foreign students, whilst it is well known that in the camp at Ruhleben a large number of interned men are young English students who had gone to Germany to complete their studies.[1]

It is gratifying to find that at the annual meeting of the Association of Education Committees held on June 8 the appeal for a comprehensive review of the whole educational work of the country at the hands of a Royal Commission or some equally authoritative body met with such significant support, nor can we read unmoved the appeal in the Educational Supplement of the *Times* for June or the strong demand in support of it of the Royal Society, the British Science Guild, and the Teachers' Guild. All through the country it is felt on the part of educationists, of men of science, and of the leaders of industry that important and speedy changes in our system and methods of education are imperative, not only in the interests of industry and commerce, but in all that makes for enlightenment and good government, and that nowhere is it more necessary than in the sphere of general education, if scientific research and its application to the nation's needs are to be made effective. We want "freedom, variety, and elasticity," with the minimum of routine control, and we must needs adopt such measures as will ensure the adequate education of all the children of the nation and the easy passage of the gifted to the highest facilities of learning the nation can offer.

THE MOULDING OF HUMANITY.

Civilisation and Climate. By Ellsworth Huntington. Pp. xii + 333. (New Haven: Yale University Press; London: Oxford University Press, 1915.) Price 10*s*. 6*d*. net.

THE effect of climate on civilisation is a fascinating subject; there is something hazardous in trying to define either of them. Both have a chequered past, and to bring the two into relation, historically and therefore prospectively as well, is an elusive but exciting pursuit. Mr. Huntington states his own position thus (p. 269):—

"The two phases of our climatic hypothesis are now before us. In point of time, though not of presentation in this book, the first step was a study of the climate of the past. Ten years of work along this line have led to the hypothesis of pulsatory changes, and finally to the idea that the changes consist primarily of a shifting of the belt of storms. After this conclusion had been reached a wholly independent investigation of the effect of present climatic conditions upon human activity led to two conclusions, neither of which was anticipated. One was that under proper conditions a relatively high temperature is not particularly harmful provided it does not go to undue extremes. The other was that changes of temperature from day to day are of great importance. On the basis of these two conclusions it at once becomes evident that the stimulating effect of climates in the same latitude and having the same kind of seasonal changes may be very different. It also becomes clear that the distribution of civilisation at the present time closely resembles that of climatic energy. From this the next step is naturally back to our previous conclusion that changes of climate in the past have consisted largely of variations in the location of the storm belt. If this is so, evidently the amount of climatic stimulus must have varied correspondingly. Thus we are led to the final conclusion that, not only at present, but also in the past, no nation has risen to the highest grade of civilisation except in regions where the climatic stimulus is great. This statement sums up our entire hypothesis."

So far as the book is concerned with the study of the variations of climate in historic time or recent geological time, it is a *résumé* and continuation of previous work by the same author, and arrives at the conclusion that both in Europe and America "the location of storms shifts in harmony with variations in the activity of the sun"; and thus we are invited to consider climatic changes as fluctuating rather than steadily progressive. One point in this connection invites further consideration—that is, the ultimate fate in this world of the accumulations of blown sand. Are they in process of being cleared away? Do they fluctuate with sunspots, or are they increasing progressively, and will sand ultimately bury modern civilisation in spite of all efforts, as it did the Egyptian yesterday?

In the study of civilisation Mr. Huntington's book strikes out a new line. We have, first of all, measures of the activity and efficiencies of workers in relation to various elements of climate and to the seasonal and casual variations of weather, from which it appears that in determining efficiency the fluctuations of weather are more important than the uniformities of climate. These studies are not always quite easy to follow. When, for example, one thinks of the output of work in Connecticut in relation to temperature one might have in mind the temperature of the workshop or of the habitation, and only in the third place of the unmitigated open air which makes climate. Indeed, in another part of his book Mr. Huntington himself suggests that warm climates may hereafter be mitigated by special measures for cooling houses, and it seems reasonable to regard cold climates as already mitigated by artificial means.

[1] In 1911 the number of full-time day students in the universities of the United Kingdom was about 20,000, in comparison with 55,000 in German universities. In our technical institutions the day students were about 2000, compared with 16,000 in the German technical high schools, with no adequate comparison on our part in respect of age, attainments on entrance, or duration of study.

Next there is a bold attempt to estimate numerically the stage of civilisation reached by different states or nations. This has been done by circular letter to 214 gentlemen, inviting each to assign to every nation under heaven its place in civilisation based upon "its power of initiative, the capacity for formulating new ideas and for carrying them into effect, the power of self-control, high standards of honesty and morality, the power to lead and control other races, the capacity for disseminating ideas . . . high ideals, respect for law, inventiveness, ability to develop philosophical systems, stability and honesty of government, a highly developed system of education, the capacity to dominate the less civilised parts of the world, and the ability to carry out far-reaching enterprises." Having received replies from 138 of the 214 correspondents, and opinions from 54, maps of the distribution of civilisation are prepared which are in curious agreement with the distribution of stimulating climate as previously defined.

It is odd that in enumerating his factors of civilisation the author says nothing about wealth or capital; and yet the maps of distribution of civilisation suggest at once the distribution of wealth more than anything else. In pessimistic moments, having regard to what is happening on this side of the Atlantic and on the other, civilisation seems to be little else than the wealth necessary "to 'maxim' other people as a Christian ought to do." A big M seems appropriate to this side, the little m to the other. A stimulating climate without the wealth necessary to protect himself strikes one as a very poor outlook for primitive man. The power to use climate to advantage must be very much a question of accumulated wealth. One can imagine a very stimulating health resort in Spitsbergen or Ross Island if it were preceded by sufficient preliminary outlay of capital and associated with some easy mode of producing wealth.

In presenting his case, therefore, Mr. Huntington has left a number of things for other people to say. The material adduced is solid or interesting, sometimes both, but the discussion is by no means closed. The book is, in fact, an invitation to others to take an interest in the subject, and the style, which is lively and unconstrained, makes the invitation still more attractive.

SALT AND ALKALI.

Manuals of Chemical Technology. VI., The Salt and Alkali Industry, including Potassium Salts and the Stassfurt Industry. By Dr. G. Martin, S. Smith, and F. Milsom. Pp. viii+100. (London: Crosby Lockwood and Son, 1916.) Price 7*s*. 6*d*. net.

THIS book constitutes No. 6 of the series of "Manuals of Chemical Technology" which are being issued under the direction of Dr. Geoffrey Martin. In scope and general character it differs in no essential features from its predecessors. No matter what may be the relative importance of the subject, the various members of the series are substantially of the same size. They are published at a uniform price, and in return the purchaser obtains with each practically the same amount of printed matter. It is impossible, under such limitations, for the authors to ensure or for the reader to expect that the various subjects shall receive even approximately adequate treatment. We have already had occasion to point out this fact in noticing the preceding manual on sulphuric acid and sulphur products. What was stated in that case applies with even greater force to the present book.

The editor states that the industries dealt with in this manual are not only among the oldest, but they are also among the largest and most important of all chemical industries. "They form, so to speak, the basis or groundwork on which are erected most of the great trades of industrial countries." Yet all that we are informed concerning these large and most important of chemical industries, including illustrations, diagrams, numerical tables, statistical and bibliographical matter, is comprised within about ninety openly spaced octavo pages. It must be obvious, therefore, that the descriptive matter can only be of the very slightest character—such, in fact, as a précis-writer might attempt.

From the fragmentary and jejune nature of the editor's preface it would seem that the book is intended for the general reader. No practical man or student of technology needs to be told how a stoppage in the supplies of salt, and hence of soda ash and salt cake, by interfering with the manufacture of window glass would hamper the building trade. Indeed, apart from the bibliography and the statistical and tabular matter, there is very little in the book of value to the specialist or the student. With one exception, to be referred to hereafter, such a compilation might be put together in a few hours in a well-furnished library like that of the Patent Office by a fairly industrious person possessing bibliographical skill and the requisite *flair* for good "copy."

That the book has been compiled under some such conditions is obvious even after a very cursory examination. There are a want of balance and a lack of a sense of proportion in the arrangement and distribution of the material. Comparatively unimportant facts receive undue attention, whereas really vital matters are dismissed in a few words, even when they obtain any notice at all. The subject of the salt industry of the world—which should include descriptions of the various methods practised in England, Germany, France, Russia, Portugal, and America—occupies about a dozen pages. The manufacture of hydrochloric acid is dealt with in less than five pages. Saltcake is disposed of in about the same space. A general survey of the sodium carbonate industry occupies less than three pages. An account of the Leblanc process, including diagrams and a slight reference to the treatment of alkali waste, is compressed within eight pages.

The one valuable feature of the work is a description of a form of the ammonia-soda process. This is evidently based upon expert knowledge,

and is both novel and interesting. It is the longest section in the book, occupying nearly one-third of the whole, and may be commended as being what the editor claims for it—the most authoritative and detailed account of the process which has yet appeared in the language.

A short account of the Stassfurt industry and of the extraction of potassium and magnesium salts, very slightly and imperfectly treated, concludes the volume.

A book of this kind may serve to show how dependent industry is upon science, and may possibly quicken the interest of the general reader in a question of which the national importance is now being forcibly brought home to us. But it is difficult to see what other useful purpose it fulfils. It certainly is not calculated to strengthen the position of any one of the branches of technological chemistry with which it professes to deal.

OPEN-AIR NATURAL HISTORY.

(1) *Rambles of a Canadian Naturalist.* By S. T. Wood. Pp. vii+247. (London: J. M. Dent and Sons, Ltd., 1916.) Price 6*s*.

(2) *The Life Story of an Otter.* By J. C. Tregarthen. New edition. Pp. xiii+188. (London: John Murray, 1915.) Price 2*s*. 6*d*.

(1) THE rambles of which Mr. S. T. Wood gives an account were pursued throughout the year, and their record makes a pleasant season-book. The studies express a blend of biological inquiry and poetic reflectiveness, and they represent an end, rather than a means, of nature-study. They put into words the joyous, intelligent appreciation which well-educated, normal human beings have, or should have, when they take country walks. "What is seen and heard—things revealed to the eye and ear—awaken a delighted interest, but our thoughts and fancies, stirred by what is partly revealed, have a deeper charm. Following these suburban rambles may yield the keen pleasure of observations verified. And, perhaps, in the wayward ramblings a community of fancy may be discovered more pleasant and more fraternal than the kindred joy of disclosing Nature's guarded secrets."

The author writes of the pitcher-plant and its interrelations, the early migrants and flowers, the renascence of spring, the honking of the wild-geese, the night-cries of the toads, the beauty of the dandelion, the midsummer birds, the life-cycle of the Promethea moth, the gorge below Niagara, the Great Northern Diver, the autumnal flocking, the haunt of the coot, some winter-visitors, and much more besides. We cannot say that we have found anything very remarkable in these essays, but we found each of them too short —which points to fine quality. They are altogether wholesome and beautiful, indirectly educative in the best sense.

Worthy of the highest praise are the characteristic colour illustrations—by Robert Holmes—of whip-poor-will, bloodroot, Promethea moth, lady's slipper, monarch butterfly, and winter's robin. There are also beautiful chapter-headings (of nature-study inspiration) by students of the Ontario College of Art. They are in fine harmony with the spirit of the book.

(2) Mr. J. C. Tregarthen's admirable "Life Story of an Otter" appears in a new edition, which deserves a wide welcome. With patience and sympathy he has been able to build up a coherent biography of a singularly elusive creature, which few naturalists know except in glimpses. His account of the education of the cubs, of the varied business of life, of the nomadism, of the combats of dog-otters, of the partnership of the pair, of the inextinguishable playfulness, and so on, is altogether admirable.

Mr. Tregarthen writes of what he has seen, his inferences are restrained, and his style suggests the open air. We do not share his enthusiasm for the otter-hunt, for which, however, he is prepared to give a reasoned defence, but we recognise the value of his first-hand observational natural history. There are some beautiful and interesting illustrations of the otter and its haunts.

OUR BOOKSHELF.

Penzance and the Land's End District. Edited by J. B. Cornish and J. A. D. Bridger. Pp. 128. (London: The Homeland Association, Ltd., n.d.) Price 6*d*. net.

THE Penzance Chamber of Commerce has conferred a boon on all visitors to their beautiful district, and especially on those who are interested in something more than mere scenery. Guide-books are generally most disappointing to anyone who seeks information on the geology or natural history of a region which is new to him, but the guide-book recently added to the Homeland series is a good example of the way in which the needs of scientific visitors may be met without in the least detracting from the usefulness of the book to the ordinary reader. The chapters dealing with each special topic have been entrusted to experts who know the district thoroughly, and they are consequently of real use to other experts or students to whom Penzance and its neighbourhood may be comparatively unknown.

The book is well got up, clearly printed in good type, very well illustrated, and is written in an easy and interesting style. There is a clear map of Penzance, and a sufficient map accompanies Mr. Dewey's lucid account of the local geology. The map of the district, however, might well be improved. It is a reproduction of the one-inch Ordnance Survey map, but seems to lack clearness. This is particularly noticeable in the names of points, bays, and places along the coast, which are often so obscured by the unnecessary shading of the sea as to be barely legible even with a lens. Again, Mr. J. B. Cornish contributes a good account of the antiquities of the district, and the value of this interesting chapter to an archæologist would be greatly enhanced if the places described could be easily identified, as by

red dots, or letters, or some such device printed on the map. This is, however, a small detail, and on the whole the book is one which we hope will be imitated for other holiday resorts.

Economics: An Introduction for the General Reader. By Henry Clay. Pp. xvi+476. (London: Macmillan and Co., Ltd., 1916.) Price 3*s.* 6*d.* net.

MR. CLAY has written a meritorious, in many ways an excellent, book; but, though his style is good and his reasoning clear, he has neither the elevated clarity of Bagehot nor the racy charm of Mr. Hartley Withers. Very rightly has he laid special emphasis both on the problems which border the two provinces of politics and ethics and on such essentially vital questions as speculation and wages. Indeed, his chapters on these last-mentioned subjects, amongst the best in the book, merit the highest praise. But the pages on banking, though containing an interesting discussion of the principles of finance, would, we fear, with their continual glib references to "runs," "liquid assets," etc., prove difficult reading for, let us say, a tutorial class; nor are such sentences as: "There is an 'intensive' as well as an 'extensive' margin of cultivation . . ." very delectable nourishment for the general reader.

The book, in fact, though in many ways an excellent elementary treatise on economics, is essentially academic.

The scope of the work has already been indicated, and includes the ordinary principles, money, banking, and finance. But it is not quite clear why Mr. Clay should consider that "the object . . . of economics is explanation solely," or that "ought" must necessarily involve a moral content. Surely it is arguable that any teleological conception may involve an appendent obligation, and that economics is a normative science. May we add that the absence of an index is not the criterion of popularity? A. L.

Methods in Practical Petrology: Hints on the Preparation and Examination of Rock Slices. By H. B. Milner and G. M. Part. Pp. vii+68. (Cambridge: W. Heffer and Sons, Ltd., 1916.) Price 2*s.* 6*d.* net.

THIS little book cannot be regarded as in any sense a complete exposition of the subject, but it contains some useful suggestions, especially on section-cutting and simple microchemical methods, incuding staining. It was, however, hardly necessary to give directions for the preparation of well-known dyes, such as fuchsine, malachite-green, and methylene-blue. We are even told how to prepare nitroso-dimethyl-aniline, one of the substances employed in the production of methylene-blue. Several pages are devoted to the subject of the classification of rocks, which is necessarily so briefly treated as to be somewhat misleading in places. If these digressions had been omitted, space would have been obtained for a more extended consideration of the practical methods with which the book is primarily concerned.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Negative Liquid Pressure at High Temperatures.

IT must have been remarked in the discussions of the various forms of equation of state for vapour-liquid (*cf.* K. Onnes and Keesom, "Ency. der Math.," or in Leyden Communications, xi., 1912, p. 727) that this equation should determine the range of possible negative pressures in liquid. If we could assume the van der Waals form of equation to hold over the wide range that is concerned, it would readily follow that negative pressure could subsist only at absolute temperatures below 27/32 of the critical point of the substance. For water the latter is 365° C.; thus in that substance internal tension could (theoretically) persist up to 538° absolute, which is 265° C. Such an order of magnitude appears at first sight surprisingly high, though really there is nothing to compare it with. By an oversight I have recently (Proc. Lond. Math. Soc., 1916, p. 191) quoted the critical point of water as 365° absolute, and so obtained the much lower limit 35° C.; and it was a reference to experiments by Prof. H. H. Dixon (Proc. R. Dublin Soc., 1914, p. 233), realising, for vegetable sap, tensions of the order of a hundred atmospheres at temperatures around 80° C., that has given rise to this correction. JOSEPH LARMOR.

Cambridge, June 24.

Science, Scholarships, and the State.

ALL scientific men must welcome the renewed vigour of the campaign for a recognition of science by the State, and incidentally for the introduction of scientific instruction into our public schools, a campaign in which NATURE has taken so prominent a part. I have followed with the greatest interest the pronouncements of the many eminent men on the subject of science and Government published from time to time, and in view of the greatness of the authorities who have written on the question it is with considerable diffidence that I direct attention to what seems to be an oversight in many of the views put forward as to the proper way to give science its due in England.

I refer to the continued proposals to found fresh scholarships for the encouragement of scientific research, accompanied as they so often are by statements as to the lack of trained men of science. In view of the present (or rather, as I have no actual experience of the present conditions in England, let us say the pre-war) attitude of the State, the universities, and private enterprise towards the men already trained, it seems to me futile to make plans for training fresh men until very definite steps have been taken to see that there are to be recognition and scope granted to them when trained. Anyone who has a knowledge of the typical careers of the most successful (from a scientific point of view) students and younger research workers will readily understand the state of things I have in mind. If a concrete example is required, the case of the 1851 Exhibition scholars may be cited: I choose this case as those scholarships are in the nature of State institutions. They would seem to be exactly of the type intended by the advocates of the establishment of new scholarships; they are, according to the conditions of award (so far as I can recollect

them), granted for promise shown in scientific research to students whose work is considered likely to be of benefit to the nation and national industries. The men who have held these scholarships for two or three years form a body highly trained in the best English and Continental universities, with, in most cases, considerable research experience under varied conditions and breadth of view. Yet we see on all hands these men barely able to make a living (unless they go to America). They are in general men of all-round education, with specialised knowledge in science in addition; they are not particularly uncouth, unpractical, or unbalanced, as popular tradition would have men of science to be. It is this addition of specialised knowledge that, under present conditions, is the greatest obstacle to their earning a living; they would probably be better paid if they turned their hand to any employment other than the pursuit of science, or became the worst paid of Government clerks.

In case I should be supposed to be taking a sordid view and claiming riches for the man of science, I explain that when I write "earning a living" I mean earning just sufficient to enable a *single* man to live in the most modest way befitting a member of a learned profession, and I state without fear of contradiction that to do so was a matter of grave difficulty for our younger men of science before the war.

There is nothing unique about the treatment of the 1851 Exhibition scholars. Taking scientific research workers in general, the State has nothing to offer them except occasional grants of 5*l.* or 10*l.* towards purchasing apparatus; the modern universities offer them (and the offer is widely accepted) 150*l.* or so a year (see the advertisement columns of NATURE) for lecturing on the higher and lower branches of their science, and for spending all their spare time in research; private enterprise treats them as amiable eccentrics on a par with the pleasant gentlemen who devise in our popular papers and magazines problems dealing with the joint ages of old families, and the division of ridiculously shaped fields into absurd areas. Only their love of science keeps them employed on scientific work, and you are not likely to extend the class of men willing to accept scholarships under such conditions and with such prospects, however many scholarships you may offer.

So long as the present attitude towards science and scientific workers obtains it is useless to train fresh men, and by means of scholarships to set keen workers on a path which leads them through the pleasant fields of scientific discovery to the pathless waste of apathy and neglect which lies in the way of all workers in pure science in England; a waste where material life is very scarcely nourished. Once the waste is abolished the path need not be made so smooth. To drop the obscurity of metaphor, once show the young and keen student that he has some hopes of employment for his activities and recognition for his work, that there is some place for him in national life when he is accomplished as a research worker, and he will derive more encouragement from the prospect of some future definite goal than from all the help by the way to nowhere offered by scholarships, exhibitions, and such like. These are of little use until there is good prospect of the attitude of the governing classes towards science being changed, and, in my humble opinion, all energies should be devoted to bringing about this change of opinion. It is conceivable that a refusal by our great men of science to do national work for nothing but scant and grudging thanks would do more to increase the national reputation of science than any sort of begging for scholarships. It would mark a new era, when the man of science will be held worthy of his hire, and not as one rather permitted to exist than encouraged; and who will be found to say that such a new era would be a bad thing?

One further point. All present discussion seems to be concerned only with the direct application of science to industry, and not at all with the advisability of encouraging pure science. Many of us would welcome a definite pronouncement from the leading authorities as to their attitude towards pure science. If only science which can be immediately applied to industrial processes is in future to be considered of national value, let us have a clear announcement to this effect from some responsible body. This will give those of us who have spent their youth working in pure science, and who are now on active service, a fair opportunity to set about cultivating the correct attitude of mind towards science before returning to peace-time pursuits. For an attitude of mind is one of the few things easily cultivated within range of German guns.

E. N. DA C. ANDRADE.

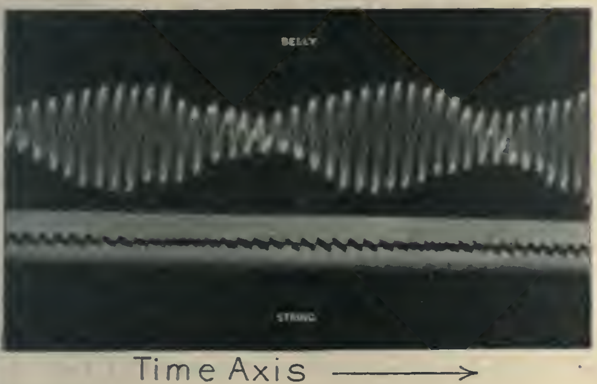
B.E.F., France, June 21.

On the "Wolf-note" of the Violin and 'Cello.

IT has long been known that on all musical instruments of the violin family there is a particular note which is difficult to excite in a satisfactory manner, and that when this "wolf-note," as it is called, is sounded, the whole body of the instrument vibrates in an unusual degree, and it seems to have been also understood that the difficulty of eliciting a smooth note of this particular pitch is due in some way to the sympathetic resonance of the instrument (Guillemin, "The Applications of Physical Forces," 1877). In a recent paper (Proc. Camb. Phil. Soc., June, 1915) G. W. White has published some experimental work confirming this view. The most striking effect noticed is the *cyclical* variation in the intensity of the tone obtained when the instrument is forced to speak at this point. White suggests as an explanation of these fluctuations of intensity that they are due to the beats which accompany the forced vibration imposed on the resonator. The correctness of this suggestion seems open to serious criticism. For the beats which are produced when a periodic force acts on a vibrator are essentially *transitory* in character, whereas in the present case the fluctuations in intensity are *persistent.*

The following explanation of the effect, which is different from that suggested by White, occurred to me some time ago on theoretical grounds, and has since been confirmed by me experimentally. The effect depends on the fact (which is itself a consequence of theory) that when the pressure with which the bow is applied is less than a certain critical value proportionate to the rate of dissipation of energy from the string, the principal mode of vibration of the latter, in which the fundamental is dominant, is incapable of being maintained and passes over into one in which the octave is prominent. When the bow sets the string in vibration the instrument is strongly excited by sympathetic resonance, and the rate of dissipation of energy rapidly increases and continues to increase beyond the limit up to which the bow can maintain the string in the normal mode of vibration. The form of vibration of the string then alters into one in which the fundamental is feeble compared with the octave. Following this, the amplitude of vibration of the belly decreases, but this change lags behind that of the string to a considerable extent. When the rate of dissipation of energy again falls below the critical limit, the string begins to regain its original form of vibration with the dominant fundamental. This is accordingly followed, after an interval, by a fresh increase in the vibration of the belly, and the cycle then repeats itself indefinitely.

The accompanying photograph showing the simultaneous vibration-curves of the belly and string of a 'cello amply confirms the foregoing explanation suggested by theory, and is itself of interest. It will be



seen that the changes in the vibrational form of the string are about a quarter of a cycle in advance of those of the belly, and that in both curves the octave is conspicuous when the amplitude is a minimum.

C. V. Raman.

The Indian Association for the Cultivation of Science, Calcutta, May 20.

THE ETHNOGRAPHY OF CENTRAL INDIA.[1]

THE publication of this work recalls the tragical fate of its author, who soon after the final revision of the proof-sheets sailed for India and lost his life in the s.s. *Persia*, sunk by a German submarine in the Mediterranean. The book is the result of a long study of the races of the Province, begun when the author was placed in charge of the census operations in 1901, and since steadily prosecuted, in spite of very indifferent health. He enjoyed opportunities denied to the writers of the volumes on Northern India—Mr. Crooke for the United Provinces and Mr. Rose for the Punjab, who dealt with regions where the all-absorbing Brahmanism and militant Islam had caused much of the more primitive beliefs and usages to disappear. Sir H. Risley, in his account of the tribes of Chota Nagpur, and Mr. Thurston, in those of the Nilgiri Hills, were dealing with people believed to be indigenous, or at least settlers of whose coming no information is now available, and their religion and organisation are of a very primitive type. The people considered by Mr. Russell are perhaps even more interesting—Gonds, Baigas, Korkus, and the like, about whom little has hitherto been known.

The scheme of Mr. Russell's work differs from that of others in the same series, inasmuch as in his Introduction and throughout the caste and tribal articles he has not confined himself to a mere description of the religious and social life. He has taken occasion to discuss questions such as the character and origin of the local totemism and animism, the Corn Spirit, the sanctity attached to opium and alcohol, the pig as a sacred animal, the buffalo as representing the Corn God, the respect paid to the umbrella and to counting, and so on. In the course of these digressions he quotes largely from standard words on anthropology, such as Sir J. G. Frazer's "The Golden Bough," "The Religion of the Semites," by Prof. Robertson Smith, "The History of Human Marriage" and "The Origin and Development of Moral Ideas," by Prof. Westermarck, and other standard authorities. This method possesses some advantages, inasmuch as it tends to popularise the principles of anthropology, and his work is learned and interesting. But it is doubtful if this advantage justifies the space which is occupied by these discussions. They are unnecessary to the trained anthropologist, and it is a question how far this learning is likely to be assimilated by the persons—the officials, European and native, of the Province—who will chiefly use the book. Further, it must be remembered, as appears from

Fig. 1.—Bahrūpia impersonating the Goddess Kāli. Reproduced from "The Tribes and Castes of the Central Provinces of India."

Prof. Ridgeway's latest book, reviewed recently in these columns, many of these principles are still the subject of active controversy.

[1] "The Tribes and Castes of the Central Provinces of India." By R. V. Russell, assisted by Rai Bahadur Hira Lal. Four volumes. Vol. i., pp. xxv+426 Vol. ii., pp. xi+540. Vol. iii., pp. xi+589. Vol. iv., pp. xi+608. (London: Macmillan and Co., Ltd., 1916.) Price 42s. net, four vols.

The scheme of the work is purely ethnographical. Anthropometry, in India at least, has fallen into some discredit since the death of Sir H. Risley, partly because it is now realised that the materials on which he based his conclusions were incomplete, partly because the groups which he discriminated have been shown to be less completely isolated than he supposed.

Much space might have been saved by compression. If, for instance, a set of standard accounts of birth, marriage, and death observances were once for all prepared, it would save constant repetition, and it would be necessary only to refer to variations from the normal practice. But the author has followed here the example of other writers in the series. When these monographs come to be revised, the scheme of arrangement might with advantage be reconsidered.

FIG. 2.—Jain Ascetics with cloth before mouth and sweeping brush. Reproduced from "The Tribes and Castes of the Central Provinces of India."

In these criticisms we must not be supposed to underrate the value of this important contribution to the ethnography of India. Every article shows the assiduous care with which the facts have been investigated; the articles are well arranged, and in the case of the less known tribes, like the Gonds, Bhils, and Korkus, much novel information is supplied, while other less distinctively local groups, like Marathas, Jats, Gujars, and Rajputs, are adequately dealt with, the articles displaying full acquaintance with the work done in other Provinces, which is invariably quoted with full acknowledgment. In almost every page there are accounts of quaint usages and beliefs of the highest interest. The work is provided with an excellent set of photographs, and its format is what might have been expected from the reputation of the publishers.

The untimely death of Mr. Russell is a serious loss to anthropology, and it is sad to think that it occurred on the eve of the publication of a book which was the work of his life, and will do much to preserve the memory of his learning and devotion to science.

BIRDS' SONGS AND THE DIATONIC SCALE.

A LETTER from Dr. R. H. Bellairs, of Cheltenham, appeared in the *Times* of June 14, describing the performance "by a wild bird, probably a thrush, of the arpeggio of the common chord in tune, absolutely in tune." This was followed by other letters, of which the *Times* printed three and gave a summary of the rest. Their contents amount to this: blackbirds do occasionally sing a few notes in our diatonic scale; thrushes less often. Only one other bird was mentioned, "the whitethroat or willow-wren," which leaves the identity of the species doubtful; and neither whitethroat nor willow-wren has ever even dimly suggested to me the use of our musical scale. But as the voices of blackbird and thrush do now and then make this suggestion, I will venture, at the Editor's request, to say a few words on the subject.

Few ornithologists are musicians, and few musicians are ornithologists, so that a knowledge of the elementary facts of the two sciences (if I may for the moment consider music as a science) is not a common acquisition. But if we are to judge of the songs of birds by reference to the diatonic scale, we must be quite clear about the following two facts: First, our present musical scale is an artificial selection, the result of a long evolutionary process, from innumerable possible intervals within the octave, and does not seem to be based on any natural human instinct, prompting to one particular selection rather than another. (See the article "Scale" in Grove's "Dictionary of Music," or Dr. Pole's "Philosophy of Music," chaps. v. and vii.)

Secondly, the vocal instrument of a bird is not constructed so as to produce with any readiness the tones of any scale consisting of fixed intervals. The pitch of the bird's notes is regulated by muscles attached to the windpipe, which is as elastic as the body of a worm; and a moment's thought will show that this is not an apparatus suited for producing a fixed succession of sound-intervals. Our reed instruments are more like the bird's organ than any others, but they are of hard material, with air-holes and a mechanism based on mathematical principles.

Combining these two facts, we may safely conclude that it needs a muscular effort, and probably a strong one, for a bird to produce anything like a tune on our scale; but at the same time it is not impossible where the notes are produced slowly and deliberately, as in the blackbird's song, and to some extent in that of the thrush. It would seem that these birds are occasionally prompted to such

an effort by an imitative instinct which is strong in all birds that sing vigorously; and they succeed in imitating with something like accuracy church bells or other musical sounds made by human beings on the diatonic scale. Sometimes this accuracy in the production of intervals may be the result of accident rather than imitation.

The difficulty that birds have in attaining this accuracy is well shown in a letter by Canon Grevile Livett (June 16), who tells how a blackbird which had attained it one year had to practise hard for a week the following spring before he recovered it. The only bird known to me whose natural "song" is on the diatonic scale is the cuckoo; and I am inclined to think that his third is not often perfect major or minor, but fluctuates between the two.

W. WARDE FOWLER.

DR. R. H. SCOTT, F.R.S.

DR. ROBERT HENRY SCOTT died on Sunday, June 18, at the advanced age of eighty-three. He was well known as the chief of the staff of the Meteorological Office from the commencement of the operations of the Meteorological Committee of the Royal Society in 1867 until his retirement on a pension in 1900, for the first nine years as Director of the Office, and for the remainder of the term as secretary of the Meteorological Council, which took over the direction of the Office in 1876. He was also secretary of the International Meteorological Committee from its commencement in 1874 until his retirement from office, and his work for that body was held in high esteem by his colleagues in all quarters of the globe. He was a fellow of the Royal Society from 1870. He received the honorary degree of D.Sc. at Dublin in 1898.

Dr. Scott was born in Dublin in 1833, a member of a well-known family. His father was a Q.C., and his mother a daughter of the Hon. Charles Brodrick, Archbishop of Cashel; one of his brothers was Headmaster of Westminster, and another was Vicar of Bray and Archdeacon of Dublin. He was educated at Rugby and Trinity College, Dublin, where he was classical scholar in 1853, and graduated as Senior Moderator in Experimental Physics in 1855. He studied also at Berlin and Munich, 1856 to 1858, chiefly chemistry, physics, and mineralogy. He was appointed Lecturer in Mineralogy to the Royal Dublin Society in 1862, and published a Manual of Volumetric Analysis in that year. He also published in the same year a translation of the second edition of "The Law of Storms, by H. W. Dove, F.R.S.," whose lectures he had attended at Berlin. The book is dedicated by the author to FitzRoy, who had translated the first edition. It was on that account that Scott was selected by the Meteorological Committee of the Royal Society, of which Sir Edward Sabine was chairman, to take charge of the Meteorological Office. His relations with Sabine were intimate, and he became his executor.

In 1861 FitzRoy, whose original duty was exclusively with the meteorology of the sea, had begun the issue of forecasts and storm-warnings, based upon the information collected daily by telegraph and charted on maps. A map of the weather is often a fascinating document, and the impulse towards sharing the information with the general public, all of whom are interested in the weather, is very difficult to resist; but some prominent members of the Royal Society thought that FitzRoy's action in publishing forecasts and storm-warnings was premature. They were interested in the continuous records of weather which they had obtained at Kew Observatory, and thought the proper plan was to have seven other observatories of the same kind and study the maps in relation to the records. The popular interest which FitzRoy's action had aroused secured for them, with the co-operation of the Admiralty and the Board of Trade, a Government grant of 10,000*l.* a year for the Office, and Scott was entrusted with the direction of the new enterprise, while a marine superintendent, Captain Henry Toynbee, was appointed to carry on the original duty of collecting and discussing marine observations.

The issue of forecasts and storm-warnings was suppressed; but at the request of the Board of Trade the issue of storm-warnings was at once revived. The telegraphic work was developed on careful lines, and the first result of Scott's work appeared in 1876 in a little book entitled "Weather Charts and Storm-Warnings." In 1879 the work had progressed so far that it was deemed appropriate by the Meteorological Council, a very powerful body of scientific experts then in control of the Office, to recommence the issue of forecasts. The issue was commenced on April 1 of that year, and has continued ever since. This was followed in 1883 by Scott's "Elementary Meteorology," in the "International Scientific Series," which took a foremost place as a textbook of meteorology.

From that time onward Scott devoted his attention mainly to the administration of the Office and to the work of the Meteorological Society, of which he became the foreign secretary, a post which he retained up to the time of his death. He was president in 1884 and 1885. He still continued to take an active interest in mineralogy and was at one time president of the Mineralogical Society. His other contributions to meteorological literature, whether official or unofficial, were mostly of a technical character.

After the great generalisation of cyclones and anti-cyclones, and their movement, which emerged almost immediately from the study of maps and records, meteorology was found to resist all ordinary endeavours to make it disclose its secrets, and it was not until the development of the study of the upper air from 1896 onwards that a fresh impetus was given to it and we learned that many of the fundamental ideas of atmospheric circulation required revision. But by that time Scott's active interest in the development of the subject had waned.

He was most methodical and punctilious in the

discharge of his many official duties. He probably never left the Office with an official letter unanswered. Perhaps it was his methodical habits which led to a number of rather serious feuds in the small meteorological circle. Certainly they did exist, though Scott himself was a kindly and thoroughly clubbable man. He was a recognised leader of the Royal Society Club and took a leading part in the incorporation therewith of the Philosophical Club. He retained his connection with the Athenæum to the last. He was an energetic and useful member of the governing body of the South-Western Polytechnic.

Shortly after his retirement he had the great misfortune to lose his wife, who was a woman of strong personality and character, and very active in the management of workmen's dwellings in Chelsea. She was a daughter of the Hon. W. Stewart, Island Secretary, Jamaica. Shortly after her death Dr. Scott had a severe fall on the stairs of the Meteorological Society and injured the base of his skull, grimly remarking when he was recovering that if he had not been Irish the accident would have been fatal. But he never completely recovered from the effects, and for the later years of his life, though he preserved all the outward forms of business, he was not able to take an active part in it. He was buried at Peper Harrow, the seat of the Brodrick family, near Godalming, on Wednesday, June 21. NAPIER SHAW.

NOTES.

THE adjourned extraordinary general meeting of the Chemical Society, called to consider the question of the removal of the names of nine alien enemies from the list of honorary and foreign members, was held on June 21, Dr. Alexander Scott, president, in the chair. Prof. W. H. Perkin's amendment, which was carried on May 11, "That judgment be suspended until after the war, in accordance with the resolution of the former council," was the motion before the meeting. As an amendment to this it was proposed by Mr. J. L. Baker, and seconded by Mr. F. F. Renwick, "That the fellows of the Chemical Society hereby record their detestation of German malpractices in connection with the war, and whilst they refrain at the present time from attaching personal responsibility for the initiation of these to individual chemists, they desire to mark their protest by resolving that the names of the following alien enemies:—A. von Baeyer, T. Curtius, E. Fischer, C. Graebe, P. H. R. von Groth, W. Nernst, W. Ostwald, O. Wallach, and R. Willstätter, shall not appear in the list of honorary and foreign members so long as the war shall last, after which their position shall be reconsidered." After considerable discussion, this amendment was put to the meeting and was declared lost. Mr. John Hodgkin then proposed a second amendment in the following terms:—"The Chemical Society considers that it is neither compatible nor consistent with its loyalty to the Crown, whence the royal charter under which it works was derived, to retain any alien enemies upon its list of honorary and foreign members. It is therefore resolved that the names of A. von Baeyer, T. Curtius, E. Fischer, C. Graebe, P. H. R. von Groth, W. Nernst, W. Ostwald, O. Wallach, and R. Willstätter, who were elected under happier conditions in recognition of their eminent services to chemical science—for which the society still retains an undiminished appreciation and regard—be, and are, hereby removed from the list of honorary and foreign members." This was seconded by Dr. S. Russell Wells, and put to the meeting, and the president declared it as carried by 94 votes to 76. The amendment was afterwards carried as a substantive motion, and the meeting then ended.

DR. J. G. ANDERSSON, until lately head of the Geological Survey of Sweden, has accepted the task of organising, as director, a Geological Survey for China.

PROF. H. THÉEL has retired from his post as intendant of the collection of invertebrate animals at the Riksmuseum, Stockholm. Dr. E. W. Dahlgren, the State Librarian, has also retired on the completion of a specially extended term of service.

THE special correspondent of the *Times* at Port Stanley (Falkland Islands), in a message dated June 26, says:—"Sir Ernest Shackleton returned here yesterday. The relief ship got to about twenty miles off Elephant Island, but was unable to make its way further through the icebergs and floating masses of ice which surrounded the island. Winter conditions in the Antarctic this year are peculiarly severe, and a more powerfully equipped ship than that lent by the Uruguayan Government is needed to force a way to Elephant Island, and relieve the twenty-two men stranded there."

THE death of Mr. Frederick Enock removes a figure well known to the public as a popular lecturer on natural history. Few, however, realised the immense amount of time he devoted to original research, chiefly into the life-histories of insects. Of recent years he devoted himself largely to the study of the Mymaridæ, or "fairy flies," a group of very minute hymenopterous parasitic insects. In this group he discovered many new genera and species, and traced out the life-histories of not a few. Unfortunately, the results of most of these investigations have not yet been published. Mr. Enock's powers of manipulation, whether as draughtsman or mounter of microscopical objects, were of a high order. Originally intended for the engineering profession, his innate passion for Nature soon asserted itself, and his life was practically all devoted to work in natural history. He had suffered for some time from pernicious anæmia, and passed away at his home at Hastings in his seventieth year.

THOSE who are interested in rites of initiation will be attracted by a paper by the Rev. Noel Roberts on "The Bagananoa or Ma-laboch: Notes on their Early History, Customs, and Creed," published in the issue of the *South African Journal of Science* for last February. It contains a very complete account of the practice of circumcision, which is the leading part of the tribal initiation rite. A remarkable feature in the beliefs of the tribe is the cult of an image of the sacred crocodile, carved out of a block of wood and kept in a secret mountain cave. A goat is sacrificed, and after it is cooked the soup is poured into a rude trough hollowed out in the underside of the image. The crocodile is known as "the father of the snake." The writer, on obviously insufficient grounds, compares this rite with the Egyptian legend of the contest between Horus, god of light, and Sut, god of darkness. The correct interpretation is probably to be found in a further study of the tribal myths, which is obviously desirable.

IN the issue of *Man* for June Mr. V. Giuffrida-Ruggeri discusses the relation of the Neolithic

Egyptians to the Ethiopians. His notes are not published in a form which admits of full examination, but he supposes that "the prehistoric series were, at least to a great extent, made up of Ethiopians, and that afterwards a great infiltration in the opposite direction took place; this infiltration must have been fed from the near east, that is, from Syria, the peninsula of Sinai, and the North African coast, territories already occupied by the Mediterranean race." Into the wider speculations advanced by the writer we cannot enter, but it is noteworthy that he assumes that the brachycephalic form of skull "does not imply any correlation to other physical characters. This skeletal character owes its exaggerated importance to the fact that it is very visible in the living man and in the series of skulls collected in museums, but in my opinion it is only valuable in determining varieties; therefore it has no value in joining together across the terrestrial space all those who are alike in that character."

A valuable "Review of the American Moles," by Mr. Hartley Jackson, has just been published by the U.S. Department of Agriculture—No. 38 of the series on the North American Fauna. In his introduction the author discusses the habits and economic status of moles, the characteristics of the young, pelages, and moults, and variations; while further details of this kind are given under the heading of the various species. Among the many interesting details the author has brought to light in the course of his investigations is the fact that the star-nosed mole (*Condylura cristata*) accumulates fat around the tail at the approach of winter. In the matter of classification, the author objects to the system proposed by Mr. Oldfield Thomas, who recognises no fewer than five subfamilies. To be consistent, he maintains, every genus would have to be raised to the rank of a subfamily. Numerous text figures, maps, and several plates add materially to the value of this most excellent piece of work.

During the past year the State of California experienced more earthquakes than all the remaining States. According to Mr. A. H. Palmer (Bull. Seis. Soc. America, vol. vi., 1916, pp. 8–28), the number of sensible shocks observed was eighty-three, of which, however, only two (those in the Imperial Valley on June 22) were of destructive intensity. Except in this valley, they were most numerous in the district bordering the Pacific coast. They were entirely absent from northern California, which includes the active volcano of Lassen Peak, and only one occurred at Lone Pine (Inyo County), the seat of the great earthquake of 1872.

Lassen Peak is not the only active volcano in the United States (excluding Alaska), but it is described by Mr. J. S. Diller as the most active (Bull. Seis. Soc. America, vol. vi., 1916, pp. 1–7). The peak rises to a height of 10,460 ft., the oldest crater is more than a mile in diameter, and, until the end of May, 1914, it had not been in action for about two centuries. The first phase of activity lasted for about a year, and consisted of more than 150 gas eruptions from a new crater formed within the old one. In May, 1915, the second phase began; a stream of lava filled both the new and old craters, and flowed some way down the western side of the mountain. This phase culminated on May 19 and 22, when hot blasts, resembling those of Mont Pelée, descended the north-eastern slope.

Though it may be long before the stratigraphy of the Philippine Isles can be correlated with that of other lands, the exploration of the country for useful products is bringing details of interest to light. Mr. W. D. Smith, in his "Geologic Reconnaissance of Mountain Province, Luzon" (*Philippine Journ. of Sci.*, vol. x., 1915, p. 177), quotes von Drasche on the definite stratification of certain uplifted coral-reefs. Von Drasche held this structure to be due to a periodic cessation in coral growth. The large part played in reef-formation by sediments intercalated between the corals is now more fully recognised. The hilly and difficult nature of the surface of the province is well illustrated. The same author deals with Panay (p. 211), where petroleum may possibly exist. Mr. W. E. Pratt, who ingenuously refers to "old" Spanish records of 1892, has an interesting paper (p. 241) on "Petroleum and Residual Bitumens in Leyte." The bitumens promise material for asphalt paving; but no large mass of porous strata is yet known in the petroleum region. The same author, in a paper on "The Persistence of the Philippine Coal-beds" (p. 289), points out encouragingly that their discontinuity is due to faulting, so that mining of the seams may some day be resumed. It should be noted that the Bureau of Science, Division of Mines, is now issuing geological maps in connection with the *Philippine Journal of Science*.

The annual report for 1914 of the Department of Mines and Geology of Mysore gives an interesting summary of progress in the mining and geological work of that State. The Mysore gold mines well maintain their output, though the Ribblesdale section has now entered a poor zone like that once passed through in the higher levels. The air-blasts or explosions of rock owing to the relief of tension during mining, which are so unusually troublesome on the Mysore goldfield, occasioned somewhat fewer fatalities, only seventeen instead of thirty-one in the year before. No method of recognising when the rock is in this explosive condition has yet been discovered. A geological map of the State on the scale of eight miles to the inch has been commenced. Dr. Smeeth, the director, again insists that the great Kaldurga conglomerates are crush conglomerates and not of sedimentary origin, a view for which the evidence has been regarded by some geologists as inadequate. He shows that many of the Mysore quartzites are intrusive into the schists, and are silicified felsites or acid quartz-porphyries. In the hope of developing the iron industry in the State the iron ores have been further studied, and Dr. Smeeth publishes a valuable report upon them. He classifies them into five groups; they include banded ironstones; ores of magmatic origin in the ultra-basic rocks and in the charnockite series, of which the latter are low-grade quartz-magnetite ores; and also various replacement ores in schists. This last group includes those which appear most likely to be of commercial value.

The recent presidential address delivered by Dr. A. W. Rogers before the Geological Society of South Africa gives an interesting description of the geology of the copper deposits of Namaqualand. He shows that the deposits of economic importance are those associated with igneous intrusions in gneiss, and thus fall into line with many of the important copper deposits in other parts of the world. The most widely distributed of these igneous rocks is mica-diorite, which is well developed at Ookiep, where, as is well known, the most important of the Namaqualand copper mines is situated. Next in importance comes norite, which appears to be of a very variable composition, ranging from rocks that differ only from the mica-diorite by the presence of a little hypersthene to rocks so rich in the latter mineral as to be almost capable of being classed as hypersthen-

ites. Hornblendites also occur, but appear not to be associated with copper deposits to the same extent as the two first-named. It will be noted that the igneous rocks are of a decidedly basic type and that they are rich in magnesian minerals, although the absence of olivine forms a constant and interesting feature in their mineralogical composition. The igneous intrusions assume many different forms, such as dykes, pipes, sheets, and irregular bodies, but no true batholites have yet been met with. No fewer than 344 such intrusions have been mapped up to the present. Very many of these rocks show a certain admixture of sulphide, including copper sulphide, in the form of interstitial grains. The question whether these sulphides are or are not original constituents of the rocks does not admit of any very precise answer, but must be decided by a review of the whole of the phenomena characterising these occurrences. Dr. Rogers concludes, upon the whole of the evidence, that the copper deposits are magmatic segregations; that "the intrusions were complex bodies of two or more differentiates from one magma basin"; that each differentiated portion of the magma held a certain quantity of sulphides at the time of intrusion; and that these sulphides often collected together within the individual differentiates, and that they were further able to migrate and to impregnate the country to a distance of a few feet from the contact. The paper forms an interesting contribution to the study of magmatic ore deposits, a group to which increasing attention has been devoted during recent years.

THE geographical problems in boundary marking are discussed by Sir Thomas H. Holdich in the *Geographical Journal* for June (vol. xlvii., No. 6). Sir T. H. Holdich has had a great deal to do with frontier delimitations in India and South America, and no man is better qualified to speak on the subject and to direct attention to the necessity of geographical knowledge on the part of the statesmen who decide frontiers. The paper gives many instances of complications, needless expense, and the threat of war due to ignorance of geographical conditions or the misapplication of geographical terms. The question will soon be one of vital importance. It may be too much to hope that expert geographical advice will be sought at least in the wording of frontier treaties, but it is nevertheless not an unreasonable demand to make.

MR. O. F. COOK gives an interesting account of agriculture and native vegetation in Peru in the Journal of the Washington Academy of Sciences, vol. vi., No. 10, May, 1916. Mr. Cook deals particularly with the region around Cuzco, the chief centre of the Inca and pre-Inca civilisation. He points out that the present distribution of the principal types of vegetation is not a natural effect of altitudes, climates, or soils, but an artificial result of intensive agricultural occupation of land over a long period of time. The primeval forest which probably clothed the hills has, in his opinion, been everywhere destroyed for agricultural purposes, and the forests which are now found are of secondary origin, having sprung up on land which has gone out of cultivation. The absence of palms in such forests is cited in support of this view. He considers that the denudation of the higher land formerly under cultivation has given rise to the large areas of grass land now sterile and abandoned.

THE Optical Society, 39 Victoria Street, Westminster, has reprinted in pamphlet form, at the price of a shilling, the paper on the manufacture and testing of prismatic compasses read recently before the Society by Mr. F. E. Smith, of the National Physical Laboratory. It describes the methods adopted at the laboratory to test the instruments for the possible errors, and gives sufficient details to enable any maker to set up without great expense his own testing arrangements. In addition, much valuable information is given as to the best form of needle, the best shape of the hard steel pivots, the superiority of garnets to agates as jewels, the proper degree of hardness of the needle (secured by the faintest straw colour in tempering), the advantage of magnetising the needles in coils giving a magnetic field of 400, and the superiority of a dead-beat motion of the needle, secured by the use of liquid, air, or magnetic damping. In practical use Mr. Smith thinks it advisable to tap the compass gently to give the needle the best chance of taking up a correct position. He finds many of the compasses at present made cannot be trusted to half a degree.

BULLETIN No. 59 of the Technological Series of the Bureau of Standards gives an account of an investigation of standard test specimens of zinc-bronze (Cu 88, Sn 10, Zn 2) by C. P. Carr and H. S. Rawdon. The authors conclude (*a*) that the addition of the small percentage of zinc does not affect the theoretical microstructure of the alloy; (*b*) that the method of casting, pouring temperature, etc., affect the structure only indirectly by influencing the rate of cooling, amount and distribution of "enclosures," etc.; (*c*) that the microstructure offers an explanation for the characteristic appearance of the tensile bars after testing; and (*d*) that of the various microstructural features affecting the physical properties, oxide films must be considered to exert by far the greatest influence. The best type of test bar where the metal is to be cast into sand is the cast-to-size shape, and if the metal is poured anywhere in the range 1270–1120° C. uniformity of tensile strength and ductility are obtained. The advantages of the cast-to-size shape are that it is easy to mould and inexpensive to machine into the shape and size required for testing. It is recommended as the form which should be adopted as standard for general foundry practice.

CONSIDERING what a fundamentally important substance it is, and the fact that it is frequently used in molecular weight determinations, one would have thought that trustworthy data for the melting and solidifying points of benzene would have been recorded long ago. From an article by Mr. R. Meldrum in the *Chemical News* for June 9, however, this does not seem to be the case. With the most nearly pure benzene commercially procurable, which was solidified at 3° C. for twenty-four hours, and then drained, this author obtained 3·92° and 3·95° C. as the solidifying point. The rate of crystallisation at this temperature, however, slackened very considerably after 10 per cent. had solidified. For the melting point, determined by keeping the thermometer immersed in the melting crystals, the value obtained was 4° C. Using the crystals solidified from the sample, after pressing between filter paper at 3° C., the author found 5·6° for the solidifying point and 5·7° for the melting point. Benzene kept in a tube of 1-in. bore at a temperature of 1° C. solidified without crystalline structure, and hence was probably in the colloidal condition. Mr. Meldrum concludes that above the melting point benzene exists in more than one modification.

THERE has just been completed on one of the main lines of the Great Central Railway a bridge over one of the English rivers (which cannot be named for military reasons) having a Scherzer rolling-lift opening span weighing 2900 tons, the largest in this country, if not, indeed, in the world. An illustrated

account of this bridge appears in *Engineering* for June 23. The bridge was designed by Mr. T. B. Ball, the engineer of the railway company, and provides for a double line of railway and for a broad road bridge, with footpaths parallel to the railway track. The lifting span gives a clear waterway 150 ft. in width. The operating gear is provided with two electric motors, each of 115 horse-power, and these are connected by gearing to the main gudgeon pins at the outer girders. The bridge is accurately balanced, with a slight preponderance to the nose end in order to prevent hammering on the bearings. The gear is sufficiently powerful to operate the bridge against a 20-lb. wind, and the time for opening, or closing, is three minutes. The bridge was constructed by Sir William Arrol and Co., Ltd., of Glasgow.

OUR ASTRONOMICAL COLUMN.

COMET 1915*e* (TAYLOR).—Messrs. Jeffers and Neubauer, of the Berkeley Astronomical Department (University of California), have calculated elements and ephemeris for this comet. Three normal places were formed from the observations, 1915, December 5–10; 1916, January 7–11 and April 5, the latter being photographic (Lick Observatory Bulletin, No. 281). The new orbit agrees very closely with the Copenhagen calculation (NATURE, March 16; see also issue for February 17):—

$$T = 1916 \text{ Jan. } 30{\cdot}9403 \text{ G.M.T.} \qquad P = 6{\cdot}3662 \text{ years}$$
$$\mu = 557{\cdot}3450''$$

Equinox 1916·0	Epoch 1916 Jan. 8·5 G.M.T.
$\omega = 354^\circ\ 49'\ 01{\cdot}6''$	$M_0 = 356^\circ\ 31'\ 33{\cdot}0''$
$\Omega = 113^\circ\ 54'\ 05{\cdot}1''$	$e = 0{\cdot}546458\ (\phi = 33^\circ\ 7'\ 27{\cdot}7'')$
$i = 15^\circ\ 31'\ 43{\cdot}5''$	$\text{Log } a = 0{\cdot}535922$

The ephemeris has been calculated to August, but the comet is stated to have been only of the fifteenth magnitude early in May.

RETURN OF DANIEL'S COMET (1909*e*).—According to new elements calculated by S. Einarsson and Margaret Harwood, the undisturbed time of perihelion passage is 1916, May 23·422 G.M.T., but the ephemeris shows that the comet will not be favourably situated for observation.

VARIATION OF LATITUDE.—In the course of a review of this subject Prof. F. Schlesinger incidentally mentions that on account of the war the second American station of the International Latitude Service may possibly be closed down (Proc. American Philosophical Society, vol. liv., No. 220). The two American stations were Gaithersburg and Ukiah. The former has already been abandoned (NATURE, March 2). An American observatory—Cincinnati—participates, but, of course, is not maintained by the international organisation.

DIFFERENCE OF LONGITUDE BETWEEN PARIS AND WASHINGTON.—Prof. Abraham's photographic method of recording wireless time signals has been tested during the past winter in the determination of the above long arc. For various reasons only seven pairs of records are available for reduction; nevertheless, comparison with the results obtained by telephonic reception is decisively favourable. M. Baillaud (*Comptes rendus*, No. 24) states that the Bureau of Longitudes has come to the conclusion that for the determination of longitudes over distances too great for the transmission of very short signals the only method which can be employed with success is that of photographic registration.

THE CONSTITUTION OF THE MILKY WAY.—Prof. C. V. Charlier has published a preliminary statement of results obtained at Lund on the distribution of the helium stars. The special significance of this group of celestial bodies is due to their close and real association with the Milky Way. As it now appears that the whole class (804 stars) has been catalogued at Harvard, they afford a unique body of data for statistical investigation (*Comptes rendus*, No. 23). The luminous radiation of these the brightest and hottest of stars is such that, viewed at the limits of the stellar universe, one of them would still appear as an 8th magnitude star. The nearest of the type is 4 siriometers (1 S.M. = 1,000,000 astronomical units) distant, and the most distant 250 S.M. The centre of the group—considered to be the probable centre of the sidereal universe—is situated in the direction of Carina ($\alpha = 7{\cdot}7$h., $\delta = -55{\cdot}6^\circ$). Two-thirds are contained in an ellipsoid of revolution having axes of 37·3 and 13·1 S.M. in the plane of the galaxy and at right angles respectively.

HYDROLOGY AT THE ARCTIC CIRCLE.[1]

THERE is something mysteriously fascinating about regions which are remote from the ordinary haunts of men. The silence of illimitable wilds and the solitudes of eternal snow stir the heart and stimulate the imagination as no other field of human enterprise can do. Explorers feel the irresistible call; pioneers grope their lonely way; by degrees the trackless unknown is traced and probed and scanned, until the survey is complete and earth's secret recesses are defined as completely and accurately as an English county.

Such is the reflection which arises as one turns over the pages of the extremely interesting hydrographical record of the Yukon-Tanana region, Alaska. Lying along the Arctic Circle, hemmed in by frozen seas and peaks of ice, this great tract of 40,000 square miles has been patiently mapped out and indexed through six long years, with praiseworthy persistence and energy, by workers in the United States Geological Survey. The preface does them but bare justice when it points out that their investigations have necessitated journeys which have put their physical endurance to severe tests and entailed considerable hardship.

The Yukon-Tanana region forms part of the central plateau of Alaska. It is an upland diversified by many broad valleys, with flat, interstream areas, above which rise numerous rounded domes and mountain masses. The surface of the upland ranges from 2000 to 3500 ft. in altitude; the domes, irregularly distributed, reach 4000 to 5000 ft., and the highest mountain crests to 6000 ft. high. The domes are almost entirely composed of igneous rocks, and the mountains of these and closely folded sediments. As a geological field, the country is one of great interest; it is a region of sedimentation, diastrophism, widespread metamorphism, abundant intrusion, and volcanic action.

The rocks may be divided into two principal groups: one consisting of metamorphic schists of pre-Ordovician origin, and the other, ranging in age from Ordovician to Carboniferous, made up of folded argillites, quartzite, conglomerate, sandstone, and limestone, resting unconformably in relation to the schists. Igneous rocks are represented by areas of granite and by dykes of varied composition. The most notable mineral resource of the country is placer gold, the developed deposits of which lie chiefly among the elder schistose and intrusive rocks. Silver, antimony, silver-lead, and tin ores are also worked.

As might be expected, the climate is one of extremes.

[1] "Surface Water Supply of the Yukon-Tanana Region, Alaska." By C. E. Ellsworth and R. W. Davenport. (Water Supply Paper No. 342.) Pp. 343, with maps, photographs, and diagrams. (Washington: United States Geological Survey. 1915.)

The annual range varies from 120° to 160° F. The maximum temperature reported is 96° F., the minimum −76° F. A range of 90° or more is experienced in the months of January and February. The winters are long and intensely cold, with the result that the ground has become frozen, in places, to depths of more than 300 ft. The effect of the brief summer warmth is merely to thaw a few feet at the surface.

The mean annual rainfall is estimated on the incomplete data available at about 12 in., but there is considerable local variation, and the records are as yet too inadequate, both in extent and duration, to permit of any definite conclusions being drawn from them. Vegetation generally takes the form of a covering of moss, beneath which is the *tundra,* a thick turf, consisting of a wet, spongy mass of roots and accumulated vegetable matter. Spruce trees are plentiful, and birch and cottonwood grow in certain areas. The conditions are scarcely such as to lead one to expect to find much horticultural development, yet it is stated in the report that in nearly every small town and in many outlying districts gardening has proved successful. Many varieties of vegetables are profitably grown for local use.

Transportation is difficult, slow, and expensive. There are three main routes, two available during the summer months only, the third mainly used for passengers and mails during the winter at considerable cost. Many outlying places are accessible with the greatest difficulty.

From the data collected, it is evident that the water resources are not adapted for hydraulic development to any extent. Mining is, of course, the principal consideration at present, and for this the winter supply is quite inadequate, while in summer the flow fluctuates considerably. Hitherto wood fuel has been exclusively used for the production of steam for power purposes, but each year the cost increases with the greater distance of transport. The problem of obtaining power is therefore annually becoming more serious with the diminution in the supply of fuel. It is one, moreover, which will have to be faced and solved before any extensive industrial development of the region becomes practicable.

B. C.

UPPER AIR INVESTIGATION.

The Meteorological Service of Canada has published an interesting account of its upper-air investigation. Part i., which is now published, deals with the records of registering balloons; the work has been done, and the report prepared by Mr. Patterson, under the direction of Mr. Stupart, the director. Ninety-four balloons were sent up, and fifty-three recovered, a fair proportion perhaps, considering the nature of the country. The instruments and methods are practically the same as in England, but the balloons have all been started at 8 p.m. local time, so as to avoid solar radiation. The mean annual temperature at each height up to 11 km. is very similar to that in England, the temperature fall per kilometre is almost identical, but the actual temperature is a degree or two higher. In view of the lower latitude this is not surprising. But in Canada the fall of temperature continues to a greater height than in Europe, the mean value of H_c being given as 11·7 km., against about 10·7 for Europe, and in consequence the temperature of the stratosphere is from 6° to 7° C. colder. Except in the case of the surface pressure, the variations of all the elements are larger in Canada; the amplitude of the seasonal variation of H_c is about 2·0, and the standard deviation is 1·96. The correlation between H_c and the pressure at 9 km. is very high, but the correlation between the surface pressure and the other quantities is very small, perhaps on account of the small variation shown by the former. The most remarkable result given is that the temperature of the stratosphere over Canada is colder in summer than in winter. The number of observations is scarcely enough to establish this with absolute certainty, but they suffice to make it almost certain, and, after all, it is no more surprising than that the lowest temperatures of the stratosphere should have been found over the equator. The general drift of the balloons, in Canada as in Europe, is towards the east, but there are a few instances of a balloon falling westward of its starting point.

GENETIC STUDIES FROM AMERICA.

A further instalment of Dr. Raymond Pearl and M. R. Curtis's "Studies on the Physiology of Reproduction in the Domestic Fowl" appears in the *Journal of Experimental Zoology,* vol. xix., No. 1. In this paper they deal with the distinction between "genetic" and "somatic" sterility. Some hens from high-laying strains, with the genetic characters for rich egg-production, were found to be sterile; the cause, when made evident by dissection, proved to be an oviduct with a mouth too narrow to afford entrance to the yolks, which, shed into the body-cavity, became absorbed through the peritoneum.

Some suggestive remarks on "Heredity and Mutation as Cell Phenomena" will be found in a paper by Dr. R. Ruggles Gates (*Amer. Journ. Bot.,* 1915, pp. 519–28), in which attention is directed to the fact that whereas the normal number of chromosomes is fourteen in Œnothera, *Œ. lata* has fifteen, one of the original chromosomes having been doubled through an irregular meiotic division; *Œ. latescens* has sixteen; and *Œ. gigas* and its derivatives have twenty-eight, the chromosome series in this case being doubled and "the plant being a cell-giant and not merely gigantic in its external dimensions."

In view of the importance now assigned by many biologists to the "mutation theory," interest will be aroused by Dr. Gates's appreciation (*Amer. Nat.,* vol. xlix., pp. 645–8) of the neglected work of Thomas Meehan (1826–91), a British gardener who settled in Philadelphia. Meehan asserted, from his observations on wild and garden plants, that "strikingly distinct forms come suddenly into existence . . . and act in every respect as acknowledged species," and that "morphological changes in individual plants are by no means by gradual modification."

CHEMICAL SCIENCE AND CIVILISATION.[1]

We who enjoy all the privileges of modern civilisation are apt to forget how much we owe to the efforts of mankind to investigate, understand, and utilise the things around them. Let me very briefly trace this element of civilisation in its relation to the chemical arts and chemical science. It is certain that the early development of human beings was dependent upon their ability to gain the mastery over other animals of greatly superior strength, speed, and power of attack. This was rendered possible by the discovery of means of making efficient weapons and tools; the former for purposes of attack and defence and for the obtaining of food, the latter for building secure habitations, tilling the ground, and

[1] From an address on "The *Rôle* of Chemical Science in Civilisation," delivered in the Lecture Theatre of the new Chemical Laboratories at University College, London, on May 16, by Prof. F. G. Donnan, F.R.S.

cooking food. Metallurgy, or the methods of extracting the metals from their ores, which is a branch of chemistry, has thus been one of the greatest factors in civilisation. Indeed, the successive discoveries of the means of extracting metals, and out of them fashioning weapons and tools, form recognised landmarks throughout the development of civilisation. Thus the age of stone has been followed by the ages of copper, bronze, iron, and steel. The science and the art of engineering, which attained to such a vast development in the nineteenth century, and of which the present century has already witnessed such a new and wonderful development in the mastery of the air, are wholly dependent on chemical science, which has provided the engineer with the chief materials for the construction of his tools, engines, machines, and structures.

The invention and development of explosives have conferred on man undreamt-of powers of action, and have raised his puny strength to that of a giant who can move mountains. Without the use of explosives we could not quarry for stone, mine for coal and metallic ores, bore tunnels and build railways, or carry out many of the great works necessary for the modern complex civilisation of the present day. The progress of engineering is thus absolutely dependent upon the progress of chemistry. The high-speed tools, the armour-plate, the aeroplanes and aeroplane engines of to-day, have only been made possible by successive advances in the application of chemical science. If men have in past ages, as at the present hour, made use of the discoveries and inventions of the chemist and the engineer to compass their own destruction, it is a question, not of chemistry and engineering, but of the imperfect development of national and international psychology. Or perhaps, from the point of view of the angels, it may represent but a fluctuating molecular turbulence in a statistically harmonious system, just as most of our laws of physics and chemistry, simple and harmonious as they appear to us to be, are but the expressions of statistically steady averages beneath which lie the wildest molecular devilry and commotion.

If we turn to the realm of art, we find that plastic and pictorial art and architecture itself are individually bound up with the discoveries and inventions of chemical craft and science. We may admire the magnificent blue of an Egyptian enamel, the white depth and the glorious hues of Chinese porcelain, the mural decoration of a Roman villa, or the splendid colours of the Book of Kells or of the painting of a Flemish master, but do we always realise that behind the imaginative work of the artist lies a long and laborious history of chemical craft and science?

I have spoken of chemistry in its relation to engineering and art. I shall not weary you with a detailed account of chemical science in its relation to the manifold material wants of modern civilisation. There exists, however, scarcely a single branch of industry that does not in some shape or form make use of chemical craft and knowledge. We are dependent upon these for paper, glass, porcelain, metals, alloys, soap, dyes, drugs, disinfectants, perfumes, etc., to mention only a few classes of common substances of daily use.

A great man once said that one could measure the civilisation of a nation by its consumption of sulphuric acid. However that may be, the present century will be dominated and characterised by the development and application of chemical science, just as the nineteenth century was characterised by the enormous development and progress of mechanical and engineering science. Germany alone of the nations of the world has had the ability and prescience to foresee this. It is chemical science that has made the power of the Germany of to-day, and however much we may loathe and abhor the policy of those who rule her, there is no gainsaying the fact that she represents a great and powerful force in material and intellectual progress. Viewed quite apart from any question concerning the morality of war in general or of the present war in particular, Germany alone amongst the nations has perceived to its full extent that the problem of organising a nation for attack or defence is largely a question of the development and organisation of chemical science and chemical industry. Previous to the war we failed to realise that vital and fundamental fact. We may dislike war, but we have to defend our honour. We have to take the world as it is and to face realities. It may be stated with a sense of the most solemn conviction that the very life-blood of England to-day is sulphuric acid. It is not a question of ethics or of polite political philosophy. It is a question of life or death. Whether we like it or not, without sulphuric acid and a few other fundamental chemical substances the honour of England would to-day be lying in the dust, and the blood of our brave manhood would have been poured out in vain, a tragic libation to the gods of vanity and ignorance.

But it is not in the grim necessities of war that I would ask you to seek the paramount importance of chemical science. Let us turn from the destruction of life to the conservation and production of life, to life itself. What do we find there? That life has chosen chemical action as the mode of its material expression. We who consider ourselves the overlords of creation are as dependent as the modest flowers beneath our feet upon the ever-recurrent ebb and flow of chemical change. The green plant is, as Huxley said, the fundamental capitalist, the producer of that store of potential chemical energy on the setting free of which in the process of oxidation all life ultimately depends. The struggle of life is the struggle for chemical energy.

Agriculture is indeed the fundamental industry of man, as it is the fundamental chemical industry. It is only by supplying the soil in increasing quantities with the required amounts of potash salts, chemically combined nitrogen, and phosphates that the ever-increasing population of the earth can be fed. The progress of agriculture is dependent upon the application of chemical science in ever-increasing measure. This applies as much to the rearing and feeding of live-stock as to the growing of plant crops. A cow is a chemical apparatus for the manufacture of milk or beef from grass and clover. For the efficient operation of this chemical machine it is necessary to make the most careful chemical study of the food or fodder which is supplied to it, and which it in its turn transforms into food for ourselves.

A man, like any other animal, requires for the performance of his work a definite stock of chemical energy, a definite diet consisting of certain determinate chemical substances, such as carbohydrates, fats, proteids, salts, and water. The amount and composition of his diet must be most carefully adjusted to the physical and mental work which he has to perform. The study of national diet from the point of view of chemical physiology is more important to the statesman and the political philosopher than many matters over which they are apt to wrangle and debate.

The cure and the prevention of disease depend ultimately on a profound understanding of the conditions which control and regulate these chemical changes. It is perhaps needless to dwell on the advances already made. Chemical science has supplied the physician

with his means of allaying pain and fever, of regulating many physiological functions, of neutralising bacterial poisons, and of determining the death of the parasites of disease. Already the chemical manufacture of pharmacologically active substances constitutes one of the vital activities of modern civilisation. But the application of chemical science to physiology and medicine is in its earliest infancy, though it will lead in time to advances as yet undreamt of. For further progress we require a finer and more subtle analysis of those wonderful chemical and physicochemical changes which preserve the mobile and dynamic equilibrium of living matter.

The problem of life, of living matter, forms one of the great goals of chemical science, on the slow and progressive solution of which depend our future existence and well-being. At the other end of the long chain of evolution lies the problem of the birth of matter. This is perhaps the other great goal of chemical science. It is a very long way from the shining nebula to the speck of protoplasm. There are many who would dig an impassable ditch in this long road.

But however that may be, the question of the synthesis and possible reconstruction of what we call our material world is one of truly transcendant importance. The discovery that the atoms of matter can, and in certain instances actually do, break up into other atoms and into electricity we owe to the genius of French and British science, and the first recognisable transmutation was discovered at University College, London, by Sir William Ramsay and Prof. Soddy. So tremendous, however, are the forces in operation during these changes that hitherto it has proved impossible to control them in any wise. I might perhaps mention that we owe to Sir William Ramsay and to Prof. Norman Collie the first determined and courageous attempts to begin this battle of the giants. We find ourselves here in a new world of chemical and molecular science. We are the spectators of forces and velocities hitherto undreamt of. But the progress of electrical science, which has ever been the fairy godmother of chemistry, gives us reason to be of good courage.

Already we know that electricity, which is but a finer form of matter, is a component of the atom. We know from the researches of von Laue and of Prof. Bragg and his son that the excessively short electric waves sent out by certain forms of electrical discharge, the so-called X- or Röntgen-rays, can penetrate and analyse the exceedingly fine-grained atomic structure of a crystal. Is it too much to hope that still shorter and denser electric waves, sent out by the most powerful sources, may be able some day to penetrate the very core and nucleus of the atom and disturb the potent equilibrium that reigns therein?

The researches of astronomers, chemists, and physicists have shown that in the gaseous nebulæ and the early stars matter exists in forms as yet unknown to us on our planet, and that as the progress of stellar evolution proceeds we gradually arrive at stars akin in nature and composition to our sun and our own world. Is it too much to hope that we may so succeed in employing electricity and electrical energy as synthetic reagents that we shall eventually, and indeed perhaps at no distant date, arrive at the production of these simple and primary forms of nebulous matter? Whether these problems will admit of solution in the near or the distant future, or whether, indeed, some of those which I have mentioned will ultimately defy all our efforts, it is here that I would ask you to seek the profound *rôle* which chemical science is destined to play in civilisation.

EVOLUTION AND SYMMETRY.[1]

IN the animal kingdom two dominant types of body symmetry are to be found. In animals that are sedentary or floating in habit the symmetry is frequently radial, but in animals that are free and move rapidly by their own muscular activity the symmetry is bilateral. In those classes of animals now sedentary in habit, which by their developmental history show a descent from a previously free and bilaterally symmetrical ancestry, a secondary radial symmetry is usually found either in the form of the body or in the arrangement of the organs for the capture of food. Similarly in the Echinodermata some examples are found, particularly in the class Holothuroidea, of animals descended from a sedentary and radially symmetrical ancestry assuming with their freedom and increased muscular activity a secondary bilateral symmetry.

In the groups of animals that are radially symmetrical, whether sedentary or floating in habit, there is usually a far greater range of variability than in those that are bilaterally symmetrical, and in the endeavour to classify them into genera and species on the Linnean system the zoologist finds so many cases of overlapping and fusion that some doubt arises as to the existence in Nature of discontinuous specific groups.

In the order of the sea-pens there is a complete series of forms connecting the radially symmetrical colonies of the genera Veretillum and Cavernularia with the bilaterally symmetrical genera Pennatula and Pterœides. In this series the difference between the range of variation in the radially symmetrical genera and that in the bilaterally symmetrical genera is very pronounced.

In such characters as the size of the zooids, the size and shape of the spicules, and the length of the axis, remarkable variations are found in the radially symmetrical genera. In the bilaterally symmetrical genera these characters are far more definitely fixed, and can usually be relied upon for determination of species.

Having examined a large number of specimens of the Pennatulacea collected by the *Siboga* expedition and in other collections in this country and abroad, the author believes that in some of the radially symmetrical genera there is no such discontinuity of structure as would justify their division into specific groups. In the bilaterally symmetrical genera, on the other hand, the existence of definite specific groups is certain. If this view is justified, the conclusion would be reached that the evolution of those discontinuous groups of specimens which are commonly recognised as species is correlated with the change from a radially symmetrical to a bilateral symmetry of the body.

The evidence at present at our disposal points very definitely to the conclusion that the radially symmetrical sea-pens are more primitive than the bilaterally symmetrical sea-pens, and evidence is produced which suggests that the former are derived from an Alcyonacean ancestry which assumed a floating or drifting habit.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The degrees conferred on Commemoration Day, June 26, included the following:—Doctor of Laws (*honoris causâ*), Dr. J. Ferguson, emeritus professor of chemistry; Doctor of Letters, W. H. Dunn, thesis, "The Development of English Biography"; Doctor of Science, Alex. Scott, thesis, "Con-

[1] Summary of the Croonian Lecture on "Evolution and Symmetry in the Order of the Sea-pens," delivered before the Royal Society on June 22 by Prof. S. J. Hickson, F.R.S.

tributions to the Petrology of the West of Scotland," with other papers; Doctor of Science in Public Health, Dr. W. Barr, thesis, "I.K. Therapy in Pulmonary Tuberculosis."

LEEDS.—Sir James Roberts, Bt., has made a gift of 10,000*l.* to the University for the foundation and maintenance of a professorship of the Russian language and literature.

LIVERPOOL.—By the will of the late Mr. N. E. Roberts 500*l.* is bequeathed to the Chancellor of Liverpool University for the benefit of the University, and 1000*l.* for the endowment of a scholarship in the department of infectious diseases, payable on the death of a niece.

LONDON.—At a meeting of the Senate held on June 21 Sir Alfred Pearce Gould was elected Vice-Chancellor for a second term of office, viz. until June, 1917. The following doctorates were conferred:—*D.Sc. in Physical Chemistry*: Mr. A. Bramley, an internal student of the Imperial College (Royal College of Science), for a thesis entitled "A Study of Binary Mixtures, with special reference to Viscosity." *D.Sc. in Chemistry*: Mr. A. F. Joseph, an internal student of the Imperial College (Royal College of Science) and Birkbeck College, for a thesis entitled "Experimental Investigations on the Properties of Bromide Solutions." *D.Sc. in Geology*: Mr. W. Jones, an external student, for a thesis entitled "The Origin of the Tin Ore Deposits of Kinta District, Federated Malay States," and other papers.

OXFORD.—The delegates of the University Museum have just presented their annual report. They direct attention to the large number of members of the teaching staff, research workers, and service staff who have been serving in the Navy or Army, or have been otherwise engaged on work directly connected with the war. In the pathological department much bacteriological work has been done for the Third Southern General Hospital; a standards laboratory has also been set up, and is occupied in the preparation and issue of standard agglutinating cultures and serums for use in the diagnosis of typhoid and paratyphoid fevers. The report in physiology records researches by the Waynflete professor, by Dr. Vernon, Dr. Chuai Asayama, of Kioto, and Prof. Denys, of Louvain. It also mentions the gaining of the V.C. by Lieut. Maling, a physiology student in 1909–10, and adds that of recent students in the department ten have lost their lives in the war. In the department of zoology and comparative anatomy research has been carried on, in the absence on military service of the Linacre professor, by the deputy-professor and Mrs. Goodrich, by Mr. G. W. Smith and Mr. J. B. Gatenby. A representative collection of insects, presented by the Hope department, has been prepared and exhibited. Since the resignation, after fifty years' service, of Prof. Clifton, the work of his department has been carried on by Mr. James Walker. Research on wireless telegraphy for the naval air service has been conducted by the Wykeham professor of physics, who reports with great regret the loss in action of Mr. H. G. J. Moseley, 2nd Lieut. R.E., already a very distinguished physicist. War work, as well as other forms of activity, has gone on, under Prof. Perkin, in the new chemistry laboratory now open. The report of Mr. H. Balfour, the curator of the Pitt-Rivers Museum, contains a long list of donations, some of the most important of which were procured by Miss M. Czaplicka during her recent expedition to Siberia. Other accessions worthy of special mention came from Mr. J. H. Hutton and from Mrs. Sollas, the latter forming part of the collection made by the late Prof. Moseley during the voyage of H.M.S. *Challenger*.

The School of Geography announces that a vacation course for teachers and others interested in geography will be held this year from August 3 to August 18. Particulars of the lectures and classes planned, with other information, may be obtained on application to the vacation course secretary, School of Geography, 40 Broad Street, Oxford.

The third conference on new ideals in education will be held at Oxford on July 29–August 5. The programme includes papers on The Boy Scout movement, by Sir Robert Baden-Powell; The place of science in education, by Sir Henry Miers; Universities and their re-planning, by Prof. Geddes; Workmanship and education, by Mr. H. Wilson; and Regional studies and human surveys, by Prof. Fleure. Among the chairmen are the Earl of Lytton, Lord Sydenham, Sir William Mather, Dr. Macan (Master of University College, Oxford), Rev. T. Provost (of Oriel College, Oxford), Mr. Fred Burridge, Miss Caroline Herford, Mr. A. C. Coffin, and others. All information with reference to the conference can be obtained from the Secretary, 24 Royal Avenue, Chelsea, S.W.

FOLLOWING on the large developments undertaken by British Dyes, Limited, the governors of the Huddersfield Technical College have decided to establish a new department for specialised study and research in coal-tar colour chemistry (aniline and alizarine dyes). The department has been placed under the headship of Dr. A. E. Everest, now lecturer in chemistry at University College, Reading, who, during recent years, has been carrying out a series of investigations upon colours and plant pigments. Work will be commenced in September next, and the department will provide advanced teaching in matters relating to the production of dyestuffs, colours, and other allied substances. Facilities will be offered for research of all kinds relating to the chemistry of colouring matters. The department will be worked in close connection with the existing departments of chemistry and of dyeing, thereby giving its students the benefit of keeping in touch with the practical application of the products to be dealt with. Spacious laboratories are to be provided, furnished with modern equipment and arranged with a view to special attention being devoted to research. The department is being founded with the full concurrence and support of the directors of British Dyes, Limited, who are prepared to contribute towards its establishment.

MIDDLESBROUGH, the most important iron centre of the north of England, has depended in the past for its research work upon the enterprise of individual firms, but the question of erecting a technical college where students could be trained efficiently to take their places in the works' laboratories has been persistently before the Education Committee for some years. A plan for erecting a college was seriously contemplated in 1914, but the outbreak of war, by preventing the raising of a loan, caused any prospect of building to be relegated to the conclusion of hostilities. The opportunity to make progress in metallurgical science was not postponed, for the Cleveland Institution of Engineers took the matter in hand and designed to start a research laboratory of its own. The plan was progressing when, on June 5, a combined meeting of the Cleveland Institution of Engineers and the education authorities of Middlesbrough and the neighbouring localities was held to hear of the munificent offer of Mr. Joseph Constantine to guarantee a sum of 40,000*l.* for the erection of a technical college on a piece of ground which had already been purchased by the Middlesbrough Town Council for such a purpose. This splendid offer

was accepted with considerable applause and gratitude, and led to other members of the meeting making further offers. Messrs. Bell Bros., Ltd., and Messrs. Dorman, Long and Co., Ltd., and their allied firms offered 10,000*l.*, and Messrs. Sir Bernard Samuelson and Co., Ltd., 5000*l.*, towards the equipment. It is expected that the sum of 100,000*l.* will be obtained without difficulty. The minor scheme of establishing a metallurgical laboratory is being proceeded with, and part of its equipment may come out of the generous donations which have been made, and at the end of the war the equipment will be transferred to the new Constantine Technical College.

It is somewhat of a novelty to find in a paper such as the *Manchester Guardian*, in its issue of June 19, a full-column advertisement urging the claims of education. But "it brings hope with it and forward-looking thoughts," since it gives welcome evidence that the value of education has at last come home to the British business man, who now sees that "national education of the broadest possible kind is the only method by which we can secure permanent British trade supremacy." The advertiser, Mr. C. F. Higham, realises that this cannot be done unless measures are taken to ensure for every child of the nation "a sound, efficient education" at the hands of more and much better paid teachers, and that such effective training should be followed by specialised teaching in every branch of industry for both employers and employed. He further urges a closer co-operation between capital and labour, and a better appreciation of their respective functions. "National education is a fundamental need." It "should be the national extravagance after the war." Let us maintain the same energy of organisation and of production for the purposes of peace that we have shown in equipment for war. The cost will be heavy, but it is the price demanded for efficiency, and, as the war has clearly shown, our financial resources are fully equal to any demands required for the well-being of the nation. This is a timely plea that British industrial enterprise shall be fostered and maintained upon a sound footing, namely, that of an "all-round enlightenment," and that no mere "tinkering with tariffs or making mild concessions after strikes will ensure it." Amidst all this strife it might, perhaps, be as well to listen to a voice of the eighteenth century, that of Rousseau in his "Emile": "To live is the trade I would teach him."

SOCIETIES AND ACADEMIES.

London.

Royal Meteorological Society, June 21.—Major H. G. Lyons, president, in the chair.—J. E. **Clark** and H. B. **Adames**: Report on the phenological observations for 1915. The year, as a whole, approximated closely to the mean for the twenty-five years over which records now extend, being, if anything, a shade earlier; but this new mean for England and Wales, falling on May 18 (taking the whole British Isles, the mean date is May 21), is a day earlier than that for the twenty years. Every one of the intervening years was early, whilst the four preceding these had been late; 1914 was seven days earlier than 1915, of which the outstanding features were the mild and very wet winter; the following period of drought, interrupted in most parts through July and early August, in others almost continuous through October; the genial conditions, as a whole, in April and June, but with cold spells and frosts in May and June; the cold, sunless, wet July, followed by a genial autumn ending in the unprecedented November frosts. The cold periods in spring affected migrants adversely, the mean date being April 26, compared with April 24 in 1914 and April 23 for the twenty years' mean of the *Natural History Journal* records, 1877 to 1896. An important appendix deals with a communication by Dr. Ihne, of Darmstadt, extending to the British Isles the mean date, in six weekly zones, of the coming of spring in various parts, such as he has carried out for the Continent. The map representing this roughly shows that Central England corresponds to Belgium, North England and the Lowlands of Scotland to Holland, and the northern Highlands to Denmark. Ireland has similar zones, except the last, the southern parts, as also in England, coming under the two earlier zones, starting from April 17.—M. **Christy** and W. **Marriott**: Audibility of the gun-firing in Flanders over the south-east of England, September, 1914–April, 1916. The sound of the fighting in Flanders has been repeatedly heard in many parts of the south-east of England since an early period of the war. From the records collected it appears that the gun-firing has been heard at one time or another over the counties of Essex, London, Kent, Surrey, and Sussex, the most distant place being about 150 miles from Ypres. The weather charts show that generally there is a somewhat irregular or not definitely defined distribution of barometric pressure, but mostly with a region of high pressure wedged in between areas of slightly lower pressure. These conditions are such as to produce light winds at the surface, mostly between north and east, over the neighbourhood of the North Sea. Aspect and elevation are also important factors for the hearing of the firing.—Lieut. F. H. **Chapman**: The relation between atmospheric pressure and rainfall at a single station. In this paper the author deals with the relationship between (1) actual pressure values and rainfall, and (2) mean pressure values and rainfall totals. The former relationship is small, and the author deals with it by the method of probability values. Curves are given showing the chances of rain at Kew during the hour 6.30 a.m.–7.30 a.m., and during the twenty-four hours 7.30 a.m.–7.30 a.m., according to the height of the barometer at 7 a.m. These curves are based on data for Kew for the ten years 1904–13. The relationship between mean pressure and rainfall totals is dealt with by the method of correlation. The coefficients obtained are high, and the corresponding regressions are shown to be very nearly linear. In this latter part of the paper, data for Kew and Valencia for the forty-seven years 1869–1915 are used.

Mineralogical Society, June 20.—Dr. A. E. H. Tutton, past-president, in the chair.—Dr. J. W. **Evans**: The relations between different laws of twinning giving the same twin-crystal. If the untwinned crystal has no symmetry, different twin-laws give different results. In the presence of a centre of symmetry an axis of rotation-twinning is an axis of reflection-twinning. An axis of rotation-twinning lying in a plane of symmetry has at right angles to it in the same plane an axis of reflection-twinning. If the normal to a plane of symmetry be an axis of rotation-twinning, or if a line of symmetry (axis of even symmetry) be an axis of reflection-twinning, the same result may be obtained by the complete inversion of the structure; *vice versâ*, in an inversion-twin the normal to every plane of symmetry is an axis of rotation-twinning, and every line of symmetry is an axis of reflection-twinning. If a twin-axis be at right angles to an axis of *n* degrees of symmetry, there will be in all *n* twin-axes of the same kind at right angles to the

same axis of symmetry. Other more complex relations were described.—Dr. G. T. **Prior**: The meteorites of Khairpur and Soko-Banja. The Khairpur meteorite is precisely similar to the Daniels Kuil, and, like it, belongs to the rare Hvittis type of chondritic stones, which contain oldhamite, and are almost free from oxide of iron. The Soko-Banja meteorite contains a small amount (4 per cent.) of nickel-iron, very rich in nickel, together with ferro-magnesian minerals rich in ferrous oxide.—Dr. G. T. **Prior**: The classification of meteorites. In chondritic stones the richer the nickel-iron in nickel the richer the ferro-magnesian minerals in ferrous oxide, and in general the smaller the amount of nickel-iron the richer it is in nickel. On these principles chondritic stones are divided into four groups corresponding to the types:—(1) Daniels Kuil; (2) Cronstad; (3) Baroti; (4) Soko-Banja. Under the same groups the meteoric irons may be arranged according to their richness in nickel, and the non-chondritic stones according to the richness in iron of the ferro-magnesian silicates, except that a fifth group is added for Eucrite, Howardite, Shergottite, Angrite, and Nakhlite, since they are richer in lime, ferrous oxide, and mostly also in alumina, than any chondritic stone at present known.—Lieut. A. **Russell**: Note on a new occurrence of gold from Cornwall. Alluvial gold was found in the bed of a small stream adjoining a jamesonite mine near Port Isaac.—A. **Holmes**: A series of volcanic rocks from the neighbourhood of the Lucalla River, Angola. The rocks described were collected by J. J. Monteiro in 1860, and include porphyritic basalts, biotite trachyte, trachyte with ægirine and cossyrite, nephelinite, and pyroxene andesite. They occur partly over Archæan, and partly over Karoo, rocks, and are probably related to the Tertiary alkali rocks between Senza do Itombe and Bango. An olivine camptonite of post-Miocene age from Dombe Grande, near Benguella, was also described.—Prof. T. L. **Walker**: Spencerite, a new zinc phosphate from British Columbia. The new mineral occurs as the core of stalactites of hemimorphite in the H.B. zinc mine near Salmo, in the West Kootenay district. It is snow-white in colour, with brilliant pearly lustre on the perfect cleavage. The three rectangular cleavages and the optical characters suggest at first sight rhombic symmetry, but complex lamellar twinning is present, and etched figures are symmetrical about one plane only. Analyses of the very pure material conform closely with the formula $Zn_3(PO_4)_2.Zn(OH)_2.3H_2O$, the mineral being a hydrated basic zinc phosphate, and thus differing from the other zinc phosphates—hopeite, parahopeite, and tarbuttite. It is named after Mr. L. J. Spencer, of the British Museum.—E. L. **Bruce**: Magnesian tourmaline from Renfrew, Ontario. Brown crystals occur at the contact of crystalline limestone and gneiss in a limestone quarry at the town of Renfrew. Analysis shows the presence of 14·53 per cent. of magnesia.

Paris.

Academy of Sciences, June 13.—M. Camille Jordan in the chair.—G. **Bigourdan**: The discovery of the visibility of the stars in full daylight, and the works of Gassendi. The author corrects his former note on this subject, as the author of the MSS. describing the appearance of Mercury in daylight was Peiresc, and not J. Gaultier.—B. **Baillaud**: Remarks on the determination of the difference of longitude between the Observatories of Paris and Washington. The figures are based on wireless telegraphy between the two stations, and the value adopted for the difference of longitude is 5h. 17m. 36·771s.—L. **Landouzy**: Observations on the note of A. Chauveau (*Comptes rendus*, 1916, p. 855). A discussion of the relations between tuberculosis and alcoholism.—C. **Guichard**: A particular class of congruences of circles.—W. H. **Young**: The basis of the theory of integration.—C. **Chéneveau**: A direct reading density balance. The instrument described permits the determination of the density of a liquid (up to 2·5) to about one unit in the third decimal place.—M. **Zenghelis**: The synthesis of ammonia. Experiments of the combination of hydrogen and nitrogen at the ordinary temperature in presence of various catalysts.—W. **Broniewski**: Martensite in the iron-carbon diagram.—F. **Zambonini**: Some observations on the composition of apatites.—C. **Sauvageau**: The "mucilage glands" of certain Laminaria.

New South Wales.

Linnean Society, March 29.—Mr. A. G. Hamilton, president, in the chair.—A. G. **Hamilton**: Presidential address. A review of the relations of birds and flowers in regard to pollination, with special reference to the Australian aspect of the subject. The entire absence of bird-pollinated flowers from the European flora is responsible for some general statements concerning the relations of insects and flowers, which are not applicable, without qualification, to other floras. Mr. Bentham, in his important paper, "Notes on the Styles of Australian Proteaceæ," was apparently unaware that, so far as is known, the highly specialised flowers of the suborder Folliculares are entirely dependent on birds for pollination, for he speaks of the possibility of insect-agency being required to transfer the pollen of certain Grevilleas to adjoining flowers. In addition to the Proteaceæ, there are numerous less specialised flowers—species of Myrtaceæ (Eucalypts, Angophora, Callistemon, Darwinia, etc.), Epacrideæ (Styphelia), Loranthaceæ, and others—which, though freely visited by birds, may not be entirely dependent on them, as these are also visited by numerous insects. The Australian "professional" pollinating birds comprise seventy-two species, in twenty-three genera, of Meliphagidæ, and seven species of brush-tongued lorikeets, besides a few species of other families which, occasionally, may play a subordinate part as amateurs. The interaction of these agencies, over a continental area, must, in the aggregate, be of some considerable magnitude. Bird-pollination is a much more difficult problem for investigation than insect-pollination. The birds are shy, and resent the presence of intruders, so that the observer can rarely approach sufficiently near to make out all-important details, and quick in their movements. The individual flowers of the Australian Proteaceæ are small, though usually massed in showy spikes or heads, and this increases the difficulty.—R. J. **Tillyard**: Studies on Australian Neuroptera. No. II.—Descriptions of new genera and species of the families Osmylidæ, Myrmeleontidæ, and Ascalaphidæ.—A. **White**: Revision of the Stratiomyidæ of Australia (Diptera). The Stratiomyidæ form one of the larger families of the Diptera, containing about one thousand species from all parts of the world. They are conspicuous flies, many of them possessing splendid metallic colouring, but, so far as the Australian species are concerned, they have been little studied. The present paper lists thirty species, belonging to eighteen genera, all the species, with one doubtful exception, and twelve of the genera being peculiar to Australia.

Cape Town.

Royal Society of South Africa, May 17.—Dr. A. Marius Wilson in the chair.—W. T. **Saxton**: Ecological notes on the district of Manubie, Transkei.

The area comprises three chief plant formations, namely, woodland, park-like grassland with scattered trees and bushes, and in the more low-lying parts of the latter, sedge vegetation. The soil is essentially uniform throughout the area, being a fine red-brown loam containing comparatively few large particles or stones. No marked differences in climatic or edaphic factors distinguish the woodland from the grass land, though these are of strikingly different appearance and are separated by a sharp boundary line.—J. S. v. d. **Lingen**: (1) Note on the radiations emitted by degenerating tissues; (2) note on the ionisation produced by degenerating nerve-muscle preparations. The author brings forward some evidence that organic tissues may *post mortem* give rise to ionisation, which can be detected by the discharge of an electroscope. On the second and third days after death the discharge seems to attain its maximum. There is also some evidence that radiations are given off which can affect photographic plates. The author states that control experiments are in progress.

BOOKS RECEIVED.

Aids to Bacteriology. By C. G. Moor and W. Partridge. Pp. viii+278. Third edition. (London: Baillière, Tindall and Cox.) 3*s*. 6*d*. net.

A Bibliography of British Ornithology, from the Earliest Times to the End of 1912, including Biographical Accounts of the Principal Writers and Bibliographies of their Published Works. By W. H. Mullens and H. Kirke Swann. Part i. Pp. 112. (London: Macmillan and Co., Ltd.) 6*s*. net.

The Declining Birth-rate: its Causes and Effects. Pp. xiv+450. (London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

University College of Wales, Aberystwyth. Agricultural Department. The Improvement of Upland Pastures. By A. E. Jones and R. G. Stapledon. Pp. 24. (Aberystwyth: John E. Evans.)

Luther Burbank: his Life and Work. By Dr. H. S. Williams. Pp. xii+333. (London: Grant Richards, Ltd.) 10*s*. 6*d*. net.

What is Coming? A Forecast of Things after the War. By H. G. Wells. Pp. 295. (London: Cassell and Co., Ltd.) 6*s*. net.

Lays of Love and Life. By Rev. E. E. Bradford. Pp. 163. (London: Kegan Paul, Trench and Co., Ltd.) 2*s*. 6*d*. net.

Survey of India. General Report, 1914–15. Pp. 40+14 maps. (Calcutta.) 2 rupees, or 3*s*.

Annals of the South African Museum. Vol. xv., part iii., containing:—(3) Contributions to the Crustacean Fauna of South Africa. By K. H. Barnard. Pp. 105–302. Plates xxvi–xxviii. (London: Adlard and Son.) 12*s*. 6*d*.

Canada. Department of Mines. Geological Survey. Memoir 55: Geology of Field Map-Area, B.C. and Alberta. By J. A. Allen. Pp. viii+312. Memoir 77: Geology and Ore Deposits of Rossland, B.C. By C. W. Drysdale. Pp. xi+317. Annual Report of the Mineral Productions of Canada during the Calendar Year 1914. Pp. 362. (Ottawa: Government Printing Bureau.)

Board of Agriculture and Fisheries. Fishery Investigations. Series ii. Sea Fisheries. Vol. iii., No. 3: An Analysis and Review of the English Plaice-Marking Experiments in the North Sea. Pp. 126. (London: H.M.S.O.; Wyman and Sons, Ltd.) 8*s*.

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1915. Pp. iv+444+98. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s*. 6*d*.

DIARY OF SOCIETIES.

THURSDAY, JUNE 29.

ROYAL SOCIETY, at 4.30.—The Determination of Gravity at Sea: Prof. A. Schuster.—The Genesis of Pleochroic Haloes: Prof. J. Joly.—Some Determinations of the Sign and Magnitude of Electric Discharges in Lightning Flashes: C. T. R. Wilson.—The Kinetic Theory of a Composite Monatomic Gas; Diffusion, Viscosity, and Thermal Conduction: S. Chapman.—Further Observations on Protozoa in relation to Soil Bacteria: Dr. T. Goodey.—New Bennettitean Cones from the British Cretaceous: Dr. M. C. Stopes.—And other Papers.

ROYAL SOCIETY OF ARTS, at 4.30.—The Sikhs: Sirdar Daljit Singh.

FRIDAY, JUNE 30.

PHYSICAL SOCIETY, at 5.—A Sensitive Magnetometer: Dr. P. E. Shaw and C. Hayes.—The Latent Heat of Fusion of a Metal and the Quantum-Theory: Dr. H. S. Allen.—Experiments on the Thermoelectric Properties of Fused Metals: C. R. Darling.—Cohesion, Part II: Prof. H. Chatley.

MONDAY, JULY 3.

ARISTOTELIAN SOCIETY, at 8.—The Import of Propositions: Prof. J. Brough.

FRIDAY, JULY 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Geology and Scenery of the Cardiff District: Prof. T. F. Sibly.

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THURSDAY, JULY 6, 1916.

OCCUPATION AND HEALTH.

Occupations: From the Social, Hygienic, and Medical Points of View. By Sir Thomas Oliver. Pp. x+110. (Cambridge: At the University Press, 1916.) Price 6*s*. net.

THE subject of this book is the influence of occupation upon health. After a brief historical introduction the author deals with the effect upon health of contamination of the air by smoke and dust, both out of doors and in factories, this discussion being followed by chapters on fatigue, on the hygienic condition of factories, on the relation of occupation to mortality, and on the choice of a career. Finally, an account is given of the harmful effects of certain dusty occupations, of gases, and of electric currents.

The brief space at his disposal and the wide scope of the subject have doubtless made it impossible for the author to give more than the merest outline of the relation of occupation to health. He does not appear, however, to have been altogether happy in his treatment of the question. Although the book contains a mass of interesting information, the reader constantly receives the impression that he is being presented with a succession of disconnected and unrelated statements. No stress has been laid upon fundamental principles, such as that health may be affected either by the nature of the occupation, or by the conditions in which the occupation is carried on. Nor has any attempt been made to distinguish essential from subsidiary factors. The chapter on fatigue, for example, contains scarcely any reference to the means by which industrial fatigue can be recognised or prevented, although recent work has shown both that diminished output is the surest evidence of fatigue, and that the introduction of short rest periods at intervals during the working day lessens the risk of over-fatigue. In view of the extreme importance of the subject, both for employer and employed, a fuller treatment of industrial fatigue would have been advantageous. The book suffers, moreover, from faulty English and from much needless repetition; a paragraph on pp. 55 and 56 is reproduced, for instance, almost word for word on pp. 65 and 66.

The least satisfactory portions of the book are those dealing with the causation of fatigue, and with the action of gases on the body; these are not up to date. In the section on the causation and nature of fatigue the author adopts the obsolete view that toxins formed during muscular exercise are the cause of fatigue; and no reference is made to the modern conception of fatigue, although most, if not all, physiologists now hold that the accumulation of lactic acid in active muscles is an important factor in its production. Again, in the chapter on gases, the author speaks of carbon monoxide toxæmia and apparently regards this gas as directly poisonous; thus the statement is made (p. 89) that carbon monoxide "may exercise a paralysing influence upon the nerves of the heart, or upon the nerve centres in the medulla oblongata." These statements are erroneous, since Haldane has shown that carbon monoxide is not directly poisonous, and that its harmful effects are due solely to the fact that it displaces oxygen from combination with hæmoglobin; and their inclusion in this book seriously detracts from its scientific value.

In spite of these defects the book contains much that is useful, especially in the chapters on factory hygiene and on dusty occupations, and although it cannot be recommended from a scientific point of view it may prove of value to the general reader.

F. A. B.

EXPERIMENTAL SPECTROSCOPY.

Collected Papers on Spectroscopy. By Prof. G. D. Liveing and Sir J. Dewar. Pp. xv+566. (Cambridge: At the University Press, 1915.) Price 30*s*. net.

THE names of Profs. Liveing and Dewar stand out prominently in the history of modern spectroscopy, and the publication of their collected papers will be cordially welcomed by all who are interested in this rapidly advancing subject. The chief results of their investigations have doubtless already become widely known through references which have appeared in text-books and in papers by other workers, but to those actually engaged in spectroscopic research it will be a great convenience to have the complete papers in this handy form. Moreover, it will be especially stimulating to students to be able to follow, step by step, the development of the authors' ideas and methods of observation.

The papers have been reprinted from the original sources, with only printers' errors corrected and the addition of a diagram for the sake of greater clearness in the description of an instrument. It may be questioned whether the wisest course has been adopted in the arrangement of the papers, which merely follow each other in the order of dates of publication. There are several instances in which a number of different papers refer to the same subject, and an arrangement in groups would not often have required the dividing up of a paper into sections. Inconvenience arising from the plan adopted, however, is considerably reduced by the addition of a classified index. There is also a useful index of names.

Excluding abstracts of papers which also appear in full, and a few lectures dealing with subjects of the authors' researches, the number of separate papers is about seventy, dating from 1877 to 1904. The first is a brief account of the phosphorescence and flame spectra of calcium fluoride, and it is fortunate that this is the only case in which positions in the spectrum are not expressed on the scale of wave-lengths. It is not possible even to enumerate the subjects of the remaining papers, but it may be mentioned that among the more extensive investigations, each of which occupies several papers, are those on the reversal

of the lines of metallic vapours, the spectra of carbon and its compounds, the ultra-violet spectra of the elements, the emission spectrum of water vapour, the spectrum of magnesium, the absorption spectrum of oxygen, and the spectra of the rare gases. There are also several papers referring to new forms of spectroscopes or details of instruments.

The general impression conveyed to the reviewer by the volume is not so much of striking discoveries as of a steady output of careful work which almost invariably contributed materially to the general advance of spectroscopy. Nevertheless, only a small part of the work can be described as having been of a routine character, and the papers have a special value on account of the great variety of experimental methods devised by the authors with definite objects in view. Thus the student or the beginner in spectroscopic research will find an abundance of useful hints on manipulation which it would be difficult to find in a convenient form elsewhere.

Perhaps the most laborious piece of work undertaken by the authors was that on the ultra-violet spectra of the elements, which involved the taking of some thousands of photographs, and the determination of wave-lengths under conditions much more difficult than would be the case at the present time. The recognition of "harmonic series" of lines, with alternating sharp and diffuse members, was a notable outcome of this work, and although the authors were not completely rewarded by the discovery of the laws of spectral series, their observations greatly facilitated the subsequent investigations of series lines by Rydberg.

Spectroscopy is full of pitfalls, largely on account of the difficulty of preparing perfectly pure substances for experiment, but the authors have had the satisfaction of themselves correcting some of their misinterpretations of observations, as in the case of certain silicon lines at first assigned to carbon, and a triplet of the Swan spectrum attributed, in the first instance, to cyanogen. It might have been expected, however, that they would have taken advantage of the opportunity of indicating, by footnotes or otherwise, further developments in connection with some of the subjects dealt with. It might have been pointed out, for example, that about 50 per cent. of the unidentified lines of atmospheric gases not condensed at the temperature of liquid hydrogen are accounted for by the second spectrum of neon discovered by Merton.

The publication of this volume can scarcely fail to stimulate further research in many directions. One point which has received less attention than it deserves is the observation by the authors that the mixed vapours of magnesium and sodium, in their experiments on reversals, yielded an absorption line about wave-length 5300, which did not appear with either vapour separately, or when sodium was replaced by potassium. Other lines were similarly found to be characteristic of a mixture of magnesium and potassium. Since mixtures of vapours are involved in the sun and stars, as well as in many of the laboratory applications of spectrum analysis, the possibility of the development of lines characteristic of mixtures would appear to be of fundamental importance. There are probably few observations which favour this supposition, but a more extended investigation is certainly desirable.

The volume concludes with a supplementary memoir, not previously published, on the separation of gases by electric discharges with various electrodes. It fully maintains the high standard of the earlier investigations, and will be appreciated, for example, by anyone who has attempted to prepare a vacuum tube of oxygen uncontaminated with carbon impurities.

The authors may well take pride in this handsome record of their long-continued labours in the field of spectroscopy, but it may be hoped that the volume is not intended to mark the termination of their contributions to the subject.

YORKSHIRE TROUT FLIES.

Brook and River Trouting: A Manual of Modern North Country Methods, with Coloured Illustrations of Flies and Fly-dressing Materials. By H. H. Edmonds and N. N. Lee. Pp. 106. (Bradford: Published by the Authors.) Price 10*s.* 6*d.* net.

THIS is an attractive little book, well produced, admirably illustrated, and written by two anglers who obviously know their subject. As what may be called a "local" manual it is as good as anything that has been produced for a long time. It has special claim to consideration in its handling of the question of flies. The authors select some three dozen patterns, commonly and profitably used on north-country streams, and make it possible for the amateur fly-dresser to be sure of getting them right by giving, besides the verbal instructions, coloured plates which show both the flies and the materials of which they are made. One plate also gives the colour shades by which fly-tying silk may be matched. The result is a really practical text-book on which, so far as it goes, the amateur can safely depend. No doubt it will be apparent to many readers that it might go farther, and that a good many favourite flies are omitted from its list. But it is at any rate arguable that the list is sufficient without them, and that an angler entirely without prejudices would do as well with it as he would with any other list of similar length designed to meet similar conditions.

The authors give brief but sound instructions as to methods of fishing on north-country streams, fly-fishing, both wet and dry, creeper and stone-fly fishing, clear-water worming, and spinning the minnow. In each case they illustrate precept by detailed experience, always a useful and interesting plan. When an angler can say "by doing so-and-so I killed so many on such-and-such occasions," and can describe the events which led up to and characterised the successes, it is more convincing than the use of bare imperatives.

The present authors have the requisite experience on which to draw, and a knack of using it pleasantly. They might have made larger demands on our patience than they have without risk of overstraining it.

It is to be understood that anyone who rules his fishing by this book surrenders himself to north-country ideas. For instance, he uses lightly dressed patterns, he learns to talk of "bloas," he renounces such tried favourites as the "blue upright" or the "coch y bonddu," becomes, in short, wedded to a particular convention. He might have to contract a similar alliance in other districts—in the Lake country, where they have "bleas," among the "bumbles" of Derbyshire, or when taking to the "half-stones" and "pheasant-tails" of the West.

Probably there is little loss of efficiency involved in such a surrender, but it is not wholly satisfactory for all that. A consideration of the various local conventions of pattern induces the reflection that there is a good deal of unnecessary confusion, some waste of effort, and some sacrifice of intelligence caused by the present system of local "water-tight compartments." Roughly, the insect life of all wet-fly streams is the same, whatever their district. Roughly, also, the intentions of all local fly-tiers are the same, to imitate those insects. But local nomenclature and idiom have largely obscured this. It would be a valuable, and we should say an extremely interesting, task for some competent fly-dresser and angler to collate all the local patterns, to select the best imitations without respect of districts, and to attempt a standardisation of wet flies which should include whatever is most worth having. Ronalds, of course, did something of the kind, and did it very well, but that was a long time ago. Since then we have had Mr. Halford's invaluable work on chalk-stream flies, and Mr. Skues's revelations on nymphs. So there are more data for such a work as is suggested.

GERMANY AND RACIAL CHARACTERS.

The Germans: (1) The Teutonic Gospel of Race; (2) The Old Germany and the New. By J. M. Robertson. Pp. viii + 291. (London: Williams and Norgate, 1916.) Price 7*s*. 6*d*.

IN the first part of his book Mr. Robertson gives an admirable and timely exposition of the crude falsity of certain current doctrines of race. The much-used "Aryan," if understood ethnologically, is almost meaningless; all that we know is that certain peoples speak Aryan languages. We do not know that those peoples, *e.g.*, in Europe, are the descendants of the invaders who brought the original Aryan speech. Similarly with skull-measurement. Many writers have claimed a generic superiority for the long-headed type—which, according to Gobineau, is that of the Teuton warrior—regardless of insuperable difficulties. For example, the Swedes are dolichocephalic, and they are not a leading nation; worse still, it is found that their best individuals are less dolichocephalic than the average. And dolichocephaly is characteristic of the negro, the Eskimo, and the gorilla. Equally fallacious is the Germans' claim that their ancestors were exceptional in their considerate treatment of women; Plutarch proves that the Ligurians excelled them, as the North American Indians did later on. Indeed, all talk about "Germanic" virtues is absurd if its aim is to glorify Germany; for East Germany is partly Slav, and Belgium and North-east France are ethnologically more Germanic than Bavaria.

Part ii. traces the process by which the Germany of Kant and Herder and Goethe became the Germany of Treitschke, Bernhardi, and the author of "The Hymn of Hate." Mr. Robertson gives an excellent historical survey, and, coming to recent times, quotes telling proofs of Germany's scheming for Britain's downfall from the writings of Prince von Bülow and other statesmen. It is clear enough now that only our supremacy at sea saved us from attack in 1900. The great blunder of Germany in 1914 was in supposing that Britain would not fulfil her treaty obligations to Belgium. Having no principles herself, no recognition of international morality, she expected a similar lack in others. Formerly few of us could believe in her criminal attitude. Now she has opened our eyes, and we see that her power must be crushed before stable peace in Europe can be hoped for.

OUR BOOKSHELF.

The Value of Science in the Smithy and Forge. By W. H. Cathcart. Pp. xiv + 163. (London: Charles Griffin and Co., Ltd., 1916.) Price 4*s*. net.

THIS handy volume is a welcome addition to the metallurgical series already issued by the same publishers. It is written by a practical smith, who is president of the Associated Foremen Smiths of Scotland. The object is to impress upon young craftsmen the value and importance of some scientific knowledge. The earlier part of the book, or about one-fourth in all, contains examples of calculations relating to forgings and simple mathematical and geometrical problems applied to practical cases. The remaining portions of the volume are those which will probably attract more attention. The subjects dealt with include metallography, heat treatment of iron and steel, the chemistry of welding, and case-hardening. In these subjects the author has acquired a skill which is altogether exceptional in a practical smith, and he writes with an enthusiasm and intimate knowledge which should commend the volume to a wider circle of readers than that for which it was originally intended.

Dr. Stead has contributed a short introduction to the volume and has taken much interest in its production. Mr. Cathcart has proved an apt pupil of Dr. Stead, upon whose researches he largely draws. References to the work of Rosenhain, Ewing, Sauveur, and others make the account more complete. It assumes some previous knowledge on the part of the young craftsman, which

he may not possess; but for those who can follow it the book should be full of charm, of interest, and of real utility. T. T.

More Minor Horrors. By Dr. A. E. Shipley. Pp. xiv + 163. (London: Smith, Elder and Co., 1916.) Price 1s. 6d. net.

THIS little volume is to be regarded as a sequel to the author's "Minor Horrors of War," and, like the latter, is written in a style calculated to entertain and instruct the layman. Dr. Shipley's innate humour leavens the "horrors" that are commonly associated with the subjects which he treats of, but at the same time he imparts information which is both accurate and up to date.

The book opens with a dissertation on the ubiquitous cockroach and its various phases of activity. The following chapter treats of the ox warble-fly, the larva of which, by destroying the continuity of the integument of our oxen, affects detrimentally an important munition of war. Mosquitoes come in for a very full share of treatment, with special reference to those which serve as carriers of malaria and yellow fever. The extension of the war into Asiatic Turkey may have possibly suggested to the author the inclusion of the fig moth in the present volume, and to dilate on the ravages it entails among the chief product of Smyrna. Among other topics the common stable fly is well described, and timely reference is made to the *rôle* which it may very likely perform in the spread of infantile paralysis.

The book is well printed and illustrated, and for the modest expenditure of eighteenpence we can glean an insight into the ways and means of some of the undesirable companions of our countrymen now fighting in divers lands and seas. A. D. IMMS.

Rhizopod Protozoa. The Causes of Cancer and Other Diseases, being Part iv. of "Protozoa and Disease." By J. J. Clarke. Pp. xiv + 187. (London: Ballière, Tindall and Cox, 1915.) Price 7s. 6d. net.

IN this book the author brings together data and observations which he considers enable him to state definitely that cancer and certain other diseases are caused by protozoa belonging to the same group of organisms as the Mycetozoa. The author has studied the mycetozoon *Dydimium difforme*, and believes that similar structures and developmental forms are met with in it and in cancers, molluscum, etc., from which he concludes that these appearances in the latter must be due to a parasite of the same botanical or zoological position as the mycetozoon. He similarly holds that the Negri bodies of rabies, the trachoma bodies, the Councilman bodies of small-pox, etc., are the actual parasites, and are protozoa, and are not, as is usually held, the "garments" enclosing an ultra-microscopic organism.

Mr. Jackson Clarke is well known for his pronounced views on the cancer question, but so far he has failed to carry conviction, and we doubt if this work will do much to advance his propaganda. The book is lavishly illustrated by a number of beautiful drawings.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Economic Geology and an Imperial Bureau of Scientific Intelligence.

THE subject of Sir R. Hadfield's address to the Ferrous Section of the Metallurgical Committee of the Advisory Council for Scientific Research (see NATURE, May 25, p. 264) is of much interest.

As far back as 1901 the Department of Agriculture and Technical Instruction for Ireland, recognising the need for obtaining information as to the economic raw materials which would be worthy of development in Ireland, decided to appoint a practical man trained in this special work. I had the honour to be the person appointed as their economic geologist.

The inquiry thus begun has resulted in furnishing considerable data as to the mineral industries already existing, and as to mineral deposits capable of development. Some progress has been made, the exports of raw materials (stones, slates, metal ores) having risen in value from 380,188*l.* in 1909 to 524,458*l.* in 1914. In the course of the inquiry a comprehensive collection of mineral raw materials, building stones, etc., was got together and shown at various exhibitions in Ireland, also at the Imperial Institute, London, and at the St. Louis Exposition, U.S.A., with the object of attracting capital to develop the deposits, finding a market for the materials already being worked, etc. The Department has thus organised what is in effect a bureau of investigation and information upon the economic side of the mineral resources of the country. Through this bureau the Department give a degree of assistance in the form of inquiry and information which goes as far as is deemed proper to Government action in any country, and of a kind which is not furnished by Government departments elsewhere in the United Kingdom.

I am in thorough agreement with Sir R. Hadfield in his proposal for the establishment of a central bureau of information as to the materials existing within the British Empire. I well know the need for such a bureau, which, in my opinion, should also collect information regarding materials exported from enemy countries, and which might be replaced by our own products. Since the beginning of hostilities I have been engaged in special inquiries and experiments, having in view, amongst other purposes, the finding of possible substitutes for raw materials imported from enemy countries, and if such a bureau had been in existence it would have been of much assistance in this work. I have had an opportunity of visiting the Philadelphia Commercial Museum, and the Commercial Museum, Brussels, and much appreciate the advantages of these institutions.

A circumstance in Irish conditions which tends considerably to facilitate the work of State action in the development of minerals is the fact that under the Land Purchase Acts of 1903 and subsequent years the mineral rights of the land sold are, as a rule, vested in the Irish Land Commission. The Department work in this matter in close co-operation with the Land Commission, my services being placed by special arrangement at the disposal of this body. The policy regarding the leasing of mineral rights is to give fair and equitable terms to the prospector.

E. ST. JOHN LYBURN.

4 Upper Merrion Street, Dublin, June 19.

The Neglect of Science.

THE following aphorisms, which have a strangely modern air, are quoted in Flaubert's "Lettres" (Paris, 1884):—

Est-il nécessaire d'observer que cette vaste science [la chimie] est absolument déplacée dans un enseignement général? A quoi sert-elle pour le ministre, pour le magistrat, pour le militaire, pour le marin, pour le négociant?

DE MAISTRE, "Lettres et opuscules inédits."

Il appartient aux prélats, aux nobles, aux grands officiers de l'Etat, d'être les dépositaires et les gardiens des vérités conservatrices, d'apprendre aux nations ce qui est mal et ce qui est bien, ce qui est vrai et ce qui est faux dans l'ordre moral et spirituel. Les autres n'ont pas le droit de raisonner sur ces sortes de matières. Ils ont les sciences naturelles pour s'amuser. De quoi pourraient-ils se plaindre?

DE MAISTRE, "Soirées de Saint-Pétersbourg." 8e *Entretien*, p. 131.

Si l'on n'en vient pas aux anciennes maximes, si l'éducation n'est pas rendue aux prêtres et si la science n'est pas mise partout à la seconde place, les maux qui nous attendent sont incalculables: nous serons abrutis par la science, et c'est le dernier degré de l'abrutissement.

DE MAISTRE, "Essai sur les principes générateurs."

Glasgow, July 1. D. M.

World-Time.

"SUMMER TIME" has come to some of the cities and towns of Canada; while the continental railways and their affiliations keep to their old "hour-belt times." I find I have to make my daily meteorological notes in 60th meridian time, although my watch runs one hour ahead. The confusion when the different time notations of tide tables, astronomical tables, railway time tables, and the town clock have to be observed cannot be obviated. It may train us, however, to be ready to adopt world-time when it is offered.

Is it not now desirable that with our continental railways and telegraphs, transoceanic cables and omnipresent wireless, we should use the same time in every part of the world? For railway travel, telegraphic contracts, news, and scientific observations it would be exact, simple, and without danger of confusion.

Suppose, when the sun is vertical to the 180th meridian from Greenwich, every clock and watch in the world should point to the hour 0 at the beginning of "the day." When vertical to the meridian of Greenwich it would be 12 everywhere. When approaching the 180th meridian the clocks would be approaching 24.

Every locality would settle its most convenient time for breakfast, etc., at, *e.g.*, 6, 8, 12, 14, or 23 o'clock. From May 1 to October 1 we could henceforward with comfort adopt the unwritten law of fixing the events one hour earlier. Nothing to puzzle over—not necessary even to change your watch an hour four times in going from Halifax to Victoria. The telegram dates in the newspapers would give us the true interval of time since the event without a calculation. Even the reductions of the diurnal temperatures of the meteorologist would be no more troublesome than they are at present under the so-called "daylight-saving," time-consuming attempt to deceive the public to its advantage.

Halifax, Nova Scotia, June 16. A. H. MACKAY.

Birds' Songs and the Diatonic Scale.

THE records of birds' songs given in the *Times* of June 14 and following days, and referred to in the interesting article by Dr. W. Warde Fowler in NATURE of June 29, are almost entirely confined to the major triad and its inversions. These three notes, though taking their place in the diatonic scale, are the least artificial part of that scale, being the third, fourth, and fifth harmonics of a fundamental note. The writer has so frequently heard these three notes sung in good tune by the blackbird in rural districts and in different parts of the country that the suggestion that the song is due to imitation seems untenable; neither does it seem necessary to attribute to the bird a mental appreciation of correct intonation. The writer hazards the suggestion that these elementary intervals are produced without mental or undue muscular effort as harmonics, just as a bugler sounds his calls on these same notes by evoking the different harmonics of his instrument.

32 Willoughby Road, N.W., July 2. C. O. BARTRUM.

STATE AFFORESTATION.

SIR JOHN STIRLING MAXWELL in three recent articles in the *Times* (June 19, 20, and 26) deals with State afforestation, which will probably prove to be one of the best means for the settlement of soldiers and sailors on the land after the war, and at the same time be effective in utilising the large tracts of waste land which are unsuitable for tillage and unprofitable for grazing. In spite of the numerous official Commissions and Committees which during the past twenty years have all agreed on the urgent need of national afforestation, little progress has been made. The Development Grant was instituted in 1909 for the express purpose of "the purchase and preparation of land for afforestation and the setting up of a number of experimental forests on a large scale"; but these objects have not been achieved. Sir John points out the probable reasons for this failure. In the past poor management and irregular sales on the majority of privately owned woodland estates, in conjunction with an unorganised timber trade and heavy and unequal rates of freight by rail on home-grown as compared with imported timber, have all combined "to turn profit into loss, and give forestry a bad name." This influenced the Development Commissioners, who limited their encouragement of forestry to "certain small but useful grants in aid of education, and in finding money to provide local forestry advisers. Of actual afforestation, a few acres planted in the water catchment areas of Liverpool and Edinburgh are the only instalments."

Conditions have naturally not improved since August, 1914. Owing to the rapidly increasing price and serious diminution in the import of foreign timber, the Government has been forced to draw extensively on home supplies; and an enormous amount of timber is now being felled in all parts of the country. This is necessary as a war measure; but we do not hear of any

precautions being taken to secure the replanting of the felled areas. The destruction of our woodlands, already much too small for our needs, is alarming. The consideration now of some definite forest policy, to be carried out immediately after the war, is a pressing matter.

Sir John Maxwell proposes a scheme for the gradual planting of the better class of waste land now included in sheep grazings and deer forests. About 6,000,000 acres can probably be profitably planted, of which 2,000,000 acres might be undertaken during the next twenty years. This is to be carried out in combination with the establishment of small holdings, the occupiers of which will do the necessary work of planting in winter, while attending to their little farms in summer. It is estimated that 10,000 acres, which under sheep or deer at present support ten or twelve families, will, if the bulk be planted, afford direct support to more than a hundred families. The dales of northern England, the valleys of Wales, and the glens of Scotland afford perfect sites for such settlements. This forest policy, here so briefly outlined, is based on an elaborate study, "The Forest Survey of Glen Mor," made by Lord Lovat and Captain Stirling of Keir, and published in 1911 by the Royal Scottish Arboricultural Society. This scheme of afforestation has the great advantage that it does not interfere in any way with existing cultivation.

The concluding article urges the immediate appointment of a small body, say three Forestry Commissioners, to whom shall be assigned the task of creating a definite area of forest within a definite time. It will take at least two years to make the necessary preparations, so that this new Commission, devoted to forestry and to nothing else, should be appointed at once. About a hundred forestry officers will utimately be required, who would be trained in forestry for two years, partly in France or Denmark and partly in this country —young men with a good scientific education to be selected, and "the temptation to employ retired Indian foresters in these posts to be resisted."

Other immediate steps advocated are the survey of districts suitable for afforestation and the selection of forest sites. The land is to be acquired by purchase or perpetual lease—compulsion to be resorted to and the price to be settled by arbitration when terms cannot be otherwise arranged. The forests should be 4000 to 10,000 acres in extent, but not necessarily inside a ring fence, as a forest may be composed of separate blocks (each not less than 500 acres in area) situated in the same district. The necessary housing for the foresters, woodmen, and labourers cannot be undertaken while the war lasts; but if men are to be absorbed from the Army after peace is made, temporary buildings, of which there will be no lack, can be used. Many other practical proposals are embodied in this comprehensive plan for the economic establishment of State forests in Great Britain and Ireland.

SCIENTIFIC DEVELOPMENT IN RUSSIA.

A REVIEW, however cursory, of scientific work in Russia during the past two years must take account of two features of outstanding interest and importance. One is the appointment, on the initiative of the Imperial Academy of Sciences of Petrograd, of a commission to investigate and report on the natural resources of the Russian Empire with a view to their scientific and practical development and utilisation.

Stated in one bald sentence this may not appear particularly impressive, but looked at through the lens of imagination it is revealed as a stupendous project with far-reaching aims and destined to lead to incalculable results. The prime incentive is the fact that in Russia, as elsewhere, the eyes of the nation have been opened and attention has been focussed on what was in times of peace known to many, deplored by some, and passively acquiesced in by all: the extent to which its economic life has been honeycombed by the greater energy, enterprise, and initiative of the Germans. It is now realised that this economic dependence, extending to many things which might just as well have been supplied by native industry, went far beyond the limits of a natural and legitimate exchange of products between neighbouring countries, and the Empire is firmly resolved to make a determined effort to put an end to an intolerable anomaly. Russia stands at the parting of the ways, and we in this year of grace are, it may be, witnessing the economic birth of a nation.

As may be supposed, the development of such a comprehensive scheme to the point of effective utility has not been accomplished without much discussion and some hostile criticism. One critic "doubts if the time is well chosen for embarking on such an ambitious enterprise when the strength of the Empire is being taxed to the utmost by this terrible war. The end proposed is highly desirable, but . . . the programme is so enormous that the preliminary steps alone will take years, to say nothing of the long interval that must elapse between scientific investigation and practical fruition . . ."; and he goes on to point out many problems to the immediate solution of which the Academy might in this crisis more profitably apply its energies. However, the commission has in a surprisingly short time got to work—the first sitting took place only in October of last year—and is issuing a series of monographs, several of which have already been published, each written by a specialist, dealing, by way of a commencement, with the vast field, in many directions undeveloped, in others lying fallow, of Russian mining and metallurgy.

The other item of interest is the convening of a conference by the Imperial Academy of Sciences to consider the proposal to found a Russian Botanical Society with its own official journal. There is a great deal of botanical investigation carried on in Russia by various institutions scattered all over the country, but it is felt that

great advantage would accrue from co-ordination and centralisation, and that the founding of such a society is only the just due of the importance of Russian botany "in view of the eminent position which Russia is destined to occupy after the war."

But side by side with these special activities, which are the direct outcome of the quickening of the nation's pulse, there is, as in normal times, a great amount of quiet, unobtrusive research in the domains of biological and physical science. Though there may be no epoch-making discovery to record, there is scarcely a field of mental activity left untilled. Many a peaceful backwater is being navigated undisturbed by the clash of arms, and it is pleasant to read of ethnographical and philological investigations, or of an expedition to the Jablonovy Range to study the local fauna, with its picturesque account of explorations in steppes, morasses, and virgin forests. It is interesting to note, in this connection, that there is scarcely a provincial town of any importance in Russia without its medical society and association of local naturalists, or, as the charming Russian idiom has it, "lovers of nature lore," true amateurs in the best sense of the word and all contributing their quota to the common stock. Worthy of mention also are the efforts made for the preservation, as far as may be possible in the circumstances, of valuable treasures of art, science, and archæology in the war-zone, such efforts not to be confined to the limits of the Empire, but to be extended to enemy territory occupied by Russia. It is pointed out that priceless products of human culture may be saved if timely measures be taken, and to this end the service of various scientific experts has been secured and the sympathetic co-operation of the military staff enlisted.

Finally, mention must be made of the decision of the Imperial Academy of Sciences on the question of the exclusion of alien enemies from the list of honorary members. As the result of a conference held in March of last year to consider the matter the Academy expresses itself as loth, by such exclusion, to place any obstacles in the way of the resumption after the war of that international co-operation for the progress of science which will, it foresees, play a greater part than ever in the development of European civilisation, "when an end has been made of those hegemonistic strivings which, not content with the sphere of politics, have invaded that of science." Truly a dignified attitude, worthy of an august institution which can look back with just pride on well-nigh two centuries of enlightened effort and solid achievement.

MORTALITY TABLES AND PREVENTIVE MEDICINE.

THE presidential address of Dr. W. W. Campbell to the American Association for the Advancement of Science at its San Francisco meeting, which was reprinted in NATURE of December 2, 1915 (xcvi., pp. 381–386), raised a question of much interest from both the scientific and practical points of view. Starting from the principle of the infallible and universal obedience to law, the strict accountability of effect to cause, which is the property of all matter, Dr. Campbell showed that the recent discoveries in preventive and curative medicine are among the most valued contributions to civilisation in the entire range of scientific research. He argued that they had increased the average length of life by many years, and that, while that increase had been greatest for children and women and those not in robust health, it had also been great for those healthy men whose lives have been accepted as risks to be insured by the life insurance companies. He suggested that during the past thirty years the increase in the duration of those lives has meant a money-saving far surpassing all the sums that universities, research institutes, and individuals have ever spent in medical investigation. In the same spirit of scientific enthusiasm, Sir William Ramsay said at Havre, a few days before the European war broke out, that "Pasteur and Lister had saved more lives than the most sanguinary of wars had destroyed."

We need not question these authoritative statements. There is a high probability that the duration of human life has increased; there is also a high probability that recent progress in preventive and curative medicine has greatly contributed to that increase. But there are also other causes which may have contributed to it. The extent of the improvement in longevity which had taken place during the nineteenth century was discussed by the fourth International Congress of Actuaries at New York, and a paper was read by Mr. Warner, actuary of the Law Union Insurance Company in London, in which he estimated the average age at death of males in England and Wales at 27·15 in 1840, 28·35 in 1870, and 33·63 in 1900; and that of females at 29·38 in 1840, 30·88 in 1870, and 36·90 in 1900—the increase during the second thirty years having been in both cases more than four times that of the previous thirty years. Though the data upon which these estimates were founded are admitted to be imperfect, their results tend to confirm the conclusions to which we have referred as highly probable. The contributory causes would seem to be greater care of infant life, better sanitation, temperance, general prosperity leading to more abundant and wholesome nutrition, and perhaps also more attention to athletics and ablutions.

Dr. Campbell, indeed, says that "life assurance business has been based upon mortality tables which represented the expectation of life under the relatively unhealthy conditions which existed a half-century ago. Those tables do not fit modern conditions." We agree with him that the law of uniformity is the foundation of actuarial science, and that given a sufficient average the rate of mortality now existing may be expected to continue to prevail as long as circumstances remain the same; but in the practical conduct of life insurance that is not the only thing to be considered. A short sketch in broad outline of its past history may serve to explain what we mean.

The early insurance companies charged a flat rate of 5*l.* per cent. for members of all ages, which was unfair to their younger members, but profitable to the companies. Then Price was lucky enough to come across the work of that worthy clerk of Northampton whose bills of mortality were prefaced each year by verses of the poet Cowper, and by the aid of those bills constructed a table of mortality. His method was erroneous, but the error was on the right side, for he made the mortality to be greater than it really was, and so as long as the Northampton table was used the prosperity of the companies continued. Then Milne constructed another table from the mortality experienced at Carlisle. Milne's methods were correct, but his table, being based on a limited local experience, was founded on insufficient data and was unevenly graduated. Still it served as a standard table for very many years, until Farr prepared from the Registrar-General's returns for the whole population the English life tables. These failed in the other direction; they were too general. We are not including in these observations the industrial insurances.

In these circumstances the Institute of Actuaries constructed a table from the actual experience of the companies, known as the H^m or healthy male table; but by the year 1893, as Mr. George King wrote, "it came to be felt that the Institute of Actuaries' experience was passing out of date." It was resolved to construct a table of mortality on the experience of sixty companies during the thirty years from 1863 to 1893, leaving out of account all the experience of the earlier days of the companies. In 1901 (not "a half-century ago," as Dr. Campbell puts it) tables based on this experience were published, and they are now the standard tables in use.

It appears from all we have said that the insurance companies have been alive to the fact that the duration of life has been gradually increasing, and have not been unwilling to give their policy-holders from time to time the benefit of the advance of knowledge in that respect. The war has now come to throw a new and lurid light on this question. It has destroyed the lives or ruined the health of many of those "whose lives have been accepted as risks to be insured." But it will come to an end some day, and normal conditions will in time be restored. Meanwhile, we may be well content with the materials with which actuarial science has already furnished us.

TROPICAL DISEASES.

THE Bulletin of the St. Louis University for January, 1916, contains a report of the work of the expedition sent by the University to British Honduras last summer for the study of tropical diseases. This expedition, intentionally planned for the purpose of a preliminary study of methods of procedure, etc., illustrates the advantage of these research expeditions. It is not that laboratories do not exist and that research is not carried out in British Honduras, but such an expedition comes with a fresh outlook on problems, and matters which may be taken to be among the most ordinary events, scarcely worthy of record in official reports, strike the members of an expedition with an entirely fresh force. We may illustrate this by two interesting examples, though perhaps not of great importance. We do not recollect in the official reports of British Honduras—and, indeed, it may be because one does not read official reports sufficiently carefully—the occurrence of poisoning, said to be common during the summer months, by the baracouta fish, nor do we recollect having heard of this on the West Coast of Africa, where the baracouta forms a welcome addition to the ordinary diet of skinny chickens. Again, the "botlass" fly (unidentified), after alighting on the skin, leaves a black, hard spot and the bite is very painful. This, again, to us is a new fact and one certainly that should be investigated.

The Bulletin has a special interest in that it contains an "In Memoriam" notice of the life and work of Dr. Edward Nelson Tobey, who was in charge of this expedition to British Honduras to study tropical diseases. He lost his life on the ship *Marowijne*, in a West Indian hurricane, on August 14. His life, as recorded here, was "one of unreached ambition and of unrealised hope. It was all effort and venture, with but little fruition and rest." The words of Meredith's sonnet on "Internal Harmony"—

So that I draw the breath of finer air
Station is nought, nor footways laurel-strewn
Nor rivals tightly belted for the race.
Good speed to them! My place is here or there;
My pride is that among them I have place:
And thus I keep this instrument in tune—

are, as those who knew "old Tobey" personally can confidently assert, well applicable to him.

J. W. W. S.

THE MITTAG-LEFFLER INSTITUTE.

IT was announced in our issue of March 23 (p. 85) that Mme. Mittag-Leffler and her husband, Prof. G. Mittag-Leffler, the eminent mathematician, had made a will devoting the whole of their property to the promotion of pure mathematics. Details of this significant foundation are given in the *Revue générale des Sciences* of May 30, from which the following particulars have been derived:—

The bequest includes their freehold villa with its contents, among which is a fine mathematical library; and an endowment to provide for its upkeep, salary of its curator, and other specified purposes. To encourage the study of pure mathematics in Sweden, Denmark, Finland, and Norway there are to be bursaries tenable by young people of both sexes belonging to these countries; they must show real aptitude for research in pure mathematics, but may pursue their studies at home or abroad. There is to be a gold medal, similar to the minor Nobel medal, for pure mathematicians belonging to the aforesaid countries who produce works above the average; and a prize for pure mathematics, to be awarded, if possible,

at least once in every six years, which is open to the whole world. The only express condition is that the award is to be for discoveries of real importance in the domain of pure mathematics.

It is intended that the director of the institute should be an eminent, and at the same time sympathetic, mathematician. The library will be available for all serious students, and they will have the privilege of consulting the director. Part of his duties will consist in giving courses of lectures to a limited number of "really gifted auditors, keenly interested in his discourses." Prof. Mittag-Leffler states that, in making his arrangements, he has taken as his model the Pasteur Institute; and the final clause of this enlightened and far-seeing document is as follows :—

Our will owes its origin to the lively conviction that a people which does not hold Mathematics in high esteem will never be able to fulfil the loftiest duties of civilisation; and that consequently it will fail to enjoy that international consideration which, in the long run, forms an effective means of preserving our status in the world, and of maintaining our right to live our individual life.[1]

We have only to add that in our opinion this is a noble example of well-directed patriotism and philanthropy which ought to lead to many imitations.

NOTES.

WE learn with much regret that Prince Boris Galitzin, professor of physics in the Imperial Academy of Sciences, Petrograd, and a distinguished worker in seismology, died on April 21/May 4.

WE notice with deep regret the announcement of the death on June 30, at seventy years of age, of Sir Gaston Maspero, the well-known Egyptologist and permanent secretary of the Académie des Inscriptions et Belles-Lettres, Paris.

THE twenty-seventh annual meeting of the Museums Association will be held at Ipswich on Tuesday and Wednesday, July 11 and 12, under the presidency of Mr. E. Rimbault Dibdin, Curator of the Walker Art Gallery, Liverpool.

THE annual general meeting of the Eugenics Education Society will be held at the Grafton Galleries, London, W., to-day (July 6), at 4 p.m., when the presidential address will be delivered by Mr. Leonard Darwin.

A SPECIAL Prize Fellowship of 100*l*., offered by the Federation of University Women to encourage research on some questions of special interest in the present national crisis, has been awarded by the Federation to Dr. Alice Lee, Fellow of University College, London. Miss Lee has collaborated for some years with Dr. Karl Pearson in many statistical investigations, and is also the author of several independent communications. She is about to undertake an investigation into the birth-rate as affected by present conditions.

IN the *Times* of July 3 its special correspondent, in describing the battle on the Somme, refers to the occasional inaudibility of the gun-firing at short distances. "Last night" (June 29), he says, "I watched the bombardment from a position commanding a view of a large section of the front. . . . It was a soft dark night, with a light westerly wind. . . . The comparative noiselessness of the bombardment from near at hand last night was very curious." On the hilltop where he stood he was unable to hear "any sound save of the guns immediately by us, with occasional bursts of sound coming quite illogically from far away. And all the while the flare and flashing of the shells was continuous."

WE regret to announce that M. Emile Waxweiler, who before the war was the director of the Solvay Institute of Sociology at Brussels University, was killed in London on June 26 by a motor-car. An appreciative account of M. Waxweiler's work, in the *Times* of June 29, points out that the sociological studies produced by him and under his direction were models of scientific inquiry. Among his best-known works before the war are his "High Wages in the United States" and "Profit Sharing." He was recently appointed director of the Belgian Office of Economic Studies, established in London to ascertain the needs of Belgian trade and industry; and he was also chosen as a delegate to the recent Economic Conference at Paris, where he was the right hand of the Belgian Premier, M. de Broqueville.

A DEPUTATION from the Royal Scottish Arboricultural Society met a number of Scottish members at the House of Commons on July 4 and laid before them the case for the creation of a Department of Forestry connected with the Board of Agriculture, for the development of forestry in Scotland, and the preparation of schemes of afforestation. In connection with this subject the Parliamentary correspondent of the *Times* states that the Government has decided to conduct an inquiry into the subject of afforestation after the war. The inquiry has been entrusted to a sub-committee of the Reconstruction Committee of the Cabinet.

THE failure of the Uruguayan trawler *Instituto Pesca* to reach Sir Ernest Shackleton's men on Elephant Island was not surprising in view of the fact that she is an unprotected vessel and made the attempt in the Antarctic midwinter. The Uruguayan Government, however, has ordered her to lie at Punta Arenas awaiting a more favourable opportunity. Meanwhile the damage she sustained in the ice is being repaired. Open water up to Elephant Island is quite possible in any month of the year, but it can never be relied on, and so the chances of the *Instituto Pesca* succeeding are most problematical. The Argentine sloop *Uruguay*, which rescued the wrecked Swedish expedition in 1903, is unfit for service. But it is reported that the Chilian Government has a wooden whaler, which has been offered to Sir Ernest Shackleton. If she is in good repair, this vessel should be able to reach the marooned men, for even if heavy pack is encountered a strong wooden ship could either force a passage or lie and wait for the pack to slacken. This appears to be the only possible ship in South American waters. A suitable ship could be secured in this country, but, at the earliest, could not reach Elephant Island before the end of August. If, however, Sir Ernest Shackleton reports that the shipping resources of South America cannot meet the demand, a vessel will be sent from home.

THE Manchester City Council (governing body of the Manchester School of Technology) has just decided to establish forthwith a new sub-department of the school for post-graduate study and research in coal-

[1] "Notre testament doit son origine à la vivante conviction qu'un peuple qui n'accorde pas aux Mathématiques un rang élevé dans son estime, ne sera jamais en état de remplir les plus hautes tâches civilisatrices et de jouir, par suite, de la considération internationale qui, elle aussi, constitue à la longue un moyen efficace de conserver notre situation dans le monde et de sauvegarder notre droit à vivre notre propre vie."

tar products and dyestuffs, and has appointed Prof. A. G. Green, F.R.S., to take charge of it. Prof. Green recently resigned the chair of tinctorial chemistry at Leeds University in order to direct the research department of the largest Lancashire firm of dyestuff manufacturers. His sub-department will be under the general direction of Prof. Knecht, who is head of the department of applied chemistry, and is expert in the use of dyestuffs, as Prof. Green is expert in their manufacture. With two such distinguished chemists in command, the Manchester School of Technology should be able to render invaluable assistance to producers and users of dyes, and so to assist materially in the development of this specially important branch of British chemical industry.

PROF. PAUL JANET, of the Sorbonne, gives in the *Revue générale des Sciences* a short account of the work of the late Prof. Eric Gerard, of the Montefiore Electrotechnical Institute, Liège. He was born in Liège on September 22, 1856, and, after graduating as an engineer at the University there in 1878, completed his studies at Paris. In 1881 he returned to Liège as professor of applied electricity at the School of Mines, and two years later was made director of the newly founded Montefiore Institute. His great abilities, both as an administrator and as a teacher, rapidly raised the institute to the prominent position it has occupied for so many years, and his "Leçons sur l'Electricité," which appeared in 1890, was recognised as a masterpiece throughout the electrotechnical world. He represented Belgium on all international electrical commissions, and his opinions had great weight with his colleagues. When Liège was attacked by the Germans in 1914 he was recuperating after the term's work at his country house, sixteen miles south-east of Liège, and only with difficulty got away to Holland. Early this year he came to England, but on his health giving way he returned to Paris, and died there on March 28 without having seen his own country.

AT the meeting of the Royal Society of Edinburgh held on July 3 the following Honorary Fellows were elected:—*British Honorary Fellows*:—Sir Francis Darwin, Cambridge; Dr. J. W. L. Glaisher, Trinity College, Cambridge; Prof. J. N. Langley, professor of physiology, Cambridge; Prof. C. Lapworth, emeritus professor of geology, University of Birmingham; Prof. A. Macalister, professor of anatomy, Cambridge; Prof. A. Schuster, emeritus professor of physics, University of Manchester. *Foreign Honorary Fellows*:—Prof. C. Barrois, professor of geology and mineralogy, Lille; Prof. D. H. Campbell, professor of botany, Leland Stanford University, Cal., U.S.A.; Prof. M. E. Gley, professor of physiology, Paris; Prof. C. Golgi, professor of anatomy, Rome; General W. C. Gorgas, U.S. Army Medical Department; Prof. G. B. Grassi, professor of comparative anatomy, Rome; Prof. E. C. Pickering, professor of astronomy, Cambridge, U.S.A.; Prof. E. Warming, emeritus professor of botany and keeper of the Royal Botanic Gardens, Copenhagen. The following prizes of the society were presented:—The Keith Prize Award for the biennial period 1913–1915 to Dr. J. H. Ashworth for his papers on "Larvæ of Lingula and Pelagodiscus" and on "Sclerocheilus," published in the Transactions of the Society, and for other papers on the morphology and histology of Polychæta; and the Neill Prize Award for the biennial period 1913–1915 to Dr. R. Campbell for his paper on "The Upper Cambrian Rocks at Craigeven Bay, Stonehaven," and "Downtonian and Old Red Sandstone Rocks of Kincardineshire," published in the Transactions of the Society.

THE Albert Medal of the Royal Society of Arts for the current year has been awarded to Prof. Elias Metchnikoff, For.Mem.R.S., "in recognition of the value of his investigations into the causes of immunity in infective diseases, which have led to important changes in medical practice, and to the establishment of principles certain to have a most beneficial influence on the improvement of public health." The annual report of the council, published in the Journal of the Society for June 30, refers to the award as follows: "The discoveries of Prof. Metchnikoff in regard to the nature of immunity to infective diseases have contributed, more than the work of any other living man, to the control of such diseases, and to the consequent improvement in the health of great European populations, and the safeguarding of those who have to face the dangers of bacterial infection, whether on the battlefield or as pioneers in tropical climates. For many years, as professor of zoology at Odessa, he was an ardent student of lower forms of life. It was by the study with the microscope of the cell activities of sponges and transparent marine organisms that he arrived at his discovery of phagocytosis. These researches into the development and metamorphoses of invertebrates prepared the way for his great discovery, as he was led by the observation of the action of the mesoderm cells in the embryonic organs of echinoderms to the knowledge that the white blood-cells or phagocytes devour the invading microbes in vertebrates also, and he was thus able to show the universal applicability of his generalisation. Prof. Metchnikoff's services to zoology and pathology are of world-wide repute, and have already been recognised by the award of the Nobel Prize for Medicine, and of the Copley Medal of the Royal Society."

Two methods of mounting fossil vertebrates are described in the *Museums Journal* for June. One of these includes the skeleton of Stenomylus, a diminutive relation of the camel. This has been recently mounted in the British Museum of Natural History in a standing posture, and partly embedded in plaster. The other is that of the skeleton of an extinct reptile, *Thescelosaurus neglectus*, which is exhibited in the United States National Museum "almost in the position in which the bones were found." It is not clear, from the description here given, whether the term "almost" refers merely to slight restoration or implies a remounting, as in the original matrix. In the latter case the method has nothing to commend it, but rather the reverse.

THE annual report of the Zoological Society of Scotland appears this year in a slightly abbreviated form, owing to the falling off of income incidental to the war. It is devoutly to be hoped that the society has weathered the worst of the storm, for the newly established Zoological Park bids fair to excel even its rival in London, at least in so far as sumptuousness in the housing of the animals is concerned. In this, of course, the natural advantages of the site play an important part. Diminishing funds have made strict economy an urgent necessity, but it is to be hoped that no further curtailments will be needed. The Carnegie Trustees have generously promised the sum of 10,000*l.* for the purpose of building and equipping an aquarium in the park, but it is not the intention of the council to proceed with the work until after the war.

THE report of the director of the Aquarium of the Zoological Society of New York, which has just reached us, has some interesting comments on the use of metal tanks for the transport of live fish.

Finding that the galvanised tanks commonly used suffered much from the rough handling to which they were subjected on shipboard, wooden tanks were substituted. These have a capacity of 156 gallons, and have proved in every way preferable. A great saving both of labour and expense has been effected by feeding the fish on alternate days instead of every day. The mortality has also decreased, an excess of fat having resulted from a too liberal diet. Altogether more than 3000 fishes, representing 140 species, are exhibited here, and among these are an unusually fine series of tropical species, and "jew-fishes" up to 500 lb. in weight. The porpoises died during the year from water fouled by sewage; to avoid losses from this source filtering tanks have been established, with eminently satisfactory results.

IN *Californian Fish and Game*, the journal published by the Board of Fish and Game Commissioners of San Francisco, vol. ii., No. 2, Mr. Chase Littlejohn gives a brief but valuable account of the habits and hunting of the sea-otter, which is fast nearing extinction. As the author was himself for some years engaged in hunting this animal, his summary makes an important addition to our knowledge of its life-history. Unlike all other aquatic mammals, the sea-otter, he tells us, swims on its back, turning swiftly over when about to dive, but he affords no information as to the part played by the tail while swimming at the surface. Sea-urchins appear to be the staple food of this animal, and these are brought to the surface and eaten as the swimmer floats upon his back. Squids and seaweed are also eaten, and occasionally fish. After man, the greatest enemy of the sea-otter is the killer-whale, from which it contrives, at times, to escape by floating at the surface as if dead. In the early days of the author's hunting, sea-otters were met with off the coasts of Japan in "schools" of as many as 400, but owing to the merciless persecution to which they have been subjected hunting is now no longer a profitable undertaking and has been abandoned.

British Birds for June contains the first of what promises to be a valuable series of records on the breeding habits of the sparrow-hawk. In the present contribution the author, Mr. J. H. Owen, describes the behaviour of the adults towards the young during rain. Ordinarily, after the young are a few days old, the hen does not require her mate to bring food to the nest. In rain, and especially in heavy rain, this is not so. She takes no notice of his calls, and he has to bring the food and deposit it on the nest. If the rain is not very heavy she will then break it up and distribute it, but in a heavy downpour she will wait until its violence has ceased rather than expose her offspring to the danger of a soaking. During pelting rain the hen, hurrying home at the first sign of the impending storm, stands over her young with outspread wings, taking especial care to cover her youngest completely. When the storm ceases she will take up her position on some neighbouring tree and expose her sodden plumage to the sun and air. The down of the nestlings seems never to get thoroughly soaked, and no attempt is made to preen it until some time after the hen has left them. This account is illustrated by some excellent photographs.

IN the Journal of the Royal Horticultural Society (vol. xli., part 3, for May) Mr. C. H. Senn contributes a useful paper on leaf vegetables and how to cook them. Vegetables are essential to both good eating and good health, so that their proper preparation and cooking are matters of the first importance. Compared with other articles of diet—fish, meat, and poultry—vegetables when properly cooked can be converted into correctly balanced food at about one-third the cost. The importance of paying attention to such matters is therefore essential, especially at the present time.

THE importance of the Canary Island palm, *Phoenix canariensis*, is referred to in Kew Bulletin No. 4. Dr. G. V. Perez states that it is the best wind-break for plantations and also that it is an ideal tree to plant along river-banks to prevent soil erosion. In addition, the hard kernels are found in the Canaries to be one of the best and most fattening foods for pigs, and they are also relished by goats. Dr. Perez mentions that he is feeding a milch-cow on the kernels after steeping them for a few days in water, and has found them useful for fattening turkeys. Palm honey can be obtained from the trees by tapping. The practice of tapping the palms was probably introduced from the opposite coast of Africa by the aborigines of the islands.

IN vol. lxxvi. of the Journal of the Royal Agricultural Society, recently issued, Dr. Winifred Brenchley describes the weeds on arable land and the best means for their suppression. Surveys of considerable areas of agricultural England have shown that comparatively few weeds are definitely associated with a single type of soil. Some of the most noxious weeds, from the farmer's point of view, are quite indifferent to soil variations; others, although of general distribution, are more frequently found on certain soils; while a small number are characteristic of particular soils, more especially sand and chalk. The methods of suppression applicable to annual and perennial weeds are dealt with generally, special treatments being prescribed for the most noxious species. Thus charlock (*Brassica arvensis*) is very susceptible to sprays of copper and iron sulphates, which do no harm to cereals growing in the same field, as their long, narrow leaves do not hold the poisons like the rough leaves of the weed. In this connection it may be noted that arsenical sprays have been used successfully abroad for weed eradication on a large scale. Sometimes a weed becomes so firmly established that ordinary methods are useless, and fallowing or a change in the rotation must be tried. As a rule, thorough cultivation of the soil at the right times—and it is here that Dr. Brenchley's paper will greatly help the farmer—is all that is required.

SOME notes on the meteorological observations of Roald Amundsen's Antarctic expedition of 1911–12 appear in *Naturen*, a monthly publication of the Bergen Museum, for March and April, 1916 (vol. xl., Nos. 3 and 4). The paper is by H. Mohn, who was responsible for the volume on meteorology in the scientific publications of the expedition. Prof. Mohn points out that the observations support the idea, advocated by Prof. Meinardus, that there is a cyclonic movement of air over the Antarctic plateau. The winds seem to have a comparatively high temperature and the characteristics of cyclonic winds. The pressure observations showed a decrease towards the Pole. The existence of cyclonic conditions over the continent would account for the heavy snowfall that must have been required for the formation of the ice-cap. On the other hand, it must be remembered that there are evidences that the snowfall in Antarctica is less than it was and insufficient to account for the formation of the ice. Certainly it is not proved that the inferior snowfall on the plateau is heavy, and it must not be forgotten that we have no winter observations, except on the coast.

AFTER many vicissitudes and much conflict of opinion, a water-supply scheme for Aberdeen has been definitely laid down, and although some time will necessarily elapse before the undertaking can be carried out in its entirety and the town enjoy the full advantages of the additional supply, it is recognised on all sides that the settlement of the vexed question is a matter for congratulation. The present supply is drawn from the Dee, and, despite strong advocacy of the merits of the Avon and the Dye, the future supply will continue to be drawn from the same source, though from a point some distance further upstream. The new intake will be at Cairnton, on the left bank of the river, twenty miles above Aberdeen. One of the principal objections raised against the Dee scheme was that, before interception, the stream passes through several populous districts, such as Braemar, Balmoral, and Ballater, which must inevitably cause some degree of pollution. On the other hand, the wide, shallow, and pebbly bed of the river lends itself admirably to the oxidation of its waters. It has been felt preferable not to rely merely on filtration and storage, but to bring about further purification by the excess lime treatment. A section of this work has already been installed, and is described, with illustrations, in the *Engineer* of June 23. The population to be supplied with water numbers 170,000, and the average daily consumption per head is computed at 40 gallons. The new scheme, as a first instalment, will provide 8½ million gallons per day, and afterwards an additional 1½ million gallons per day.

OUR ASTRONOMICAL COLUMN.

A JUNE METEORIC DISPLAY.—Mr. W. F. Denning writes from Bristol:—"On the evening of June 28, after a cloudy, oppressive day, the atmosphere cleared. On going out into my garden to commence observations at about 10.25 G.M.T., I almost immediately saw that a very rich and unexpected display of meteors was in progress.

"Continuing to watch until 12.15, I saw fifty-five meteors, including many fine ones. Then clouds interrupted, but these had drifted away and left the sky clear again at 12.45, and fourteen additional meteors were seen in half an hour.

"The radiant was at $230°+54°$, and there seemed to be a well-marked companion centre near β Boötis at $223°+41°$. The meteors were slow, and all the brighter ones left evanescent trains of sparks. The shower seems quite unknown, but there are rich radiants in Quadrans on January 2 and October 2."

THE VISIBILITY OF STARS IN DAYLIGHT.—Among other interesting items, a note in the *Observatory* (June) records that Sirius was seen with the naked eye by Mr. A. E. M. Fleming one minute before sunset on April 18. It may be stated here that M. Bigourdan has now obtained grounds for believing that the observation referred to in NATURE, June 15, should really be ascribed to Peiresc (*Comptes rendus*, No. 24).

THE LARGE METEORITE OF FEBRUARY 13, 1915.—This object fell in the Chusan Archipelago, near Video, and an interesting description of the facts attending its fall, by Mr. W. F. Tyler, appears in the Journal of the Royal Asiatic Society (vol. xlvi., 1915). Mr. Tyler alludes to many of the observations and discusses the real path, but the data were somewhat conflicting, and he found it impossible to harmonise them and derive a perfectly trustworthy result. He concludes that the meteorite probably exhibited a curved flight, being directed from N.N.E. at first and from N.W. towards the end. As to the actual dimensions of the meteor, Mr. Tyler concludes that the incandescent mass at one point of its path was 1500 ft. in diameter, while at the end it had declined to 80 ft.

Mr. Tyler has done the best he could with discordant materials, but it is far easier to assume that the obviously rough observations were wrong than that the meteor had a very devious course. The writer would prefer to adopt a straight course of about 60 geographical miles from N. by W.

As to the diameter, the actual nucleus was probably not more than two or three feet in diameter. It is well known that meteoric bodies when incandescent appear enormously larger than they really are. Thus the meteorite which fell near Wigan on October 13, 1914, gave a brilliant illumination and thunder-like reports over a wide area, though it only weighed 33 lb. when afterwards discovered.

THE MOTION OF THE NUCLEI OF COMET 1915*e* (TAYLOR).—In a series of measures of the nuclei of Taylor's comet, made at Bergedorf by H. Thiele between February 19 and April 3, the distance showed little change, but the position angle varied considerably. The observation gave a period of about thirty days. If this is considered to be a rotational motion the total mass of the comet would be about 10^{-10} (*Astronomische Nachrichten*, No. 4846).

ON CENTRE—LIMB SHIFTS OF SOLAR WAVE-LENGTHS.—An important memoir dealing with this subject, by Mr. J. Evershed and Dr. T. Royds, appears as Bulletin No. xlix. of the Kodaikanal Observatory. The alterations of wave-lengths of certain iron lines have been studied in greater detail over the sun's disc, and it appears that they begin to be measurable not far from the centre (0·3 of the radius). Thus the displacements cannot be due to differential pressure effects. The inverse relation between the limb shift and centre shift is held to indicate that they have a common origin. The authors prefer to seek the cause in line-of-sight motion rather than in anomalous dispersion, although recognising the possibility of basing thereon an attractive explanation. The Döppler effects would result if there exists a general motion directed away from the earth all over the disc. A crucial test of the hypothesis, it is suggested, would be afforded by measures of lines in the spectrum of that face of the sun reflected from the planet Venus.

METALLOGRAPHIC METHODS IN AMERICA.

IN a paper on "A Metallographic Description of Some Ancient Peruvian Bronzes from Machu Picchu," Mr. C. H. Matthewson, in the *American Journal of Science* (No. 240, December, 1915), gives an interesting account of the detailed application of modern metallographic methods to the study of ancient metal objects with the view of arriving at an insight into the methods of working employed by those who fashioned the various objects. Some work of this kind has already been done by Garland, Hadfield, and Rosenhain, but the present paper carries the matter further, for the author has carried out a somewhat extensive series of experiments on the behaviour of the tin-copper alloys under cold and hot working and annealing, in order to arrive as closely as possible at the precise mode of treatment which each of the thirty-three objects examined had undergone. While in general terms it has always been possible to determine from a microscopic examination of such an object whether it has been cast or wrought, Matthewson endeavours to carry the matter further and to

establish with some degree of accuracy at what temperature working has been carried out and what ranges and durations of annealing have been employed. For this purpose he makes use of measurements of grain-size, of a classification of the degree of "coring" or of "homgenisation" which has been produced, and also of the various indications of cold work or overstrain. Quite apart from its archæological interest, the paper represents a valuable study of the behaviour of the tin-copper alloys ranging in tin-content from about 2 to 14 per cent. under mechanical deformation and annealing. Less happy are the author's excursions into the domain of theories of plastic strain and of annealing in metals generally; they burden a lengthy paper with much additional matter scarcely relevant to the subject.

From the Scientific Materials Co., of Pittsburgh, U.S.A., we have received pamphlets descriptive of the Simatco apparatus for the determination of transformation or critical points in iron, steel, or alloys, and of appliances for general metallographic work. While it is difficult to form any real opinion on such appliances without having seen them and tested them in actual use, the fact that special apparatus of this kind is now being placed upon the market in America is significant of the widespread development and application of metallography. So far as can be gathered from the very clear descriptions and illustrations of the apparatus given in the pamphlets, much of it appears to be highly convenient and ingenious; on the other hand, certain features are obviously open to serious criticism. For instance, the claim is made that a very simple form of well-lagged electrically-wound furnace can by means of a special rheostat be caused to give a uniform rate of rise and fall of temperature over a wide range, and it seems most unlikely that this can be realised. The form of specimen adopted is also open to objection on the ground that much of the metal is further away from the thermo-couple than is necessary or permissible. The shape adopted arises from the use of a leading-in tube of special shape—in itself very convenient—by which the wires of the thermo-couples are brought into the specimen. This shape of tube, however, demands a very wide hole, and the effort to compensate for this by a "deep immersion" results in an unsatisfactory shape. Further, for indicating the temperatures of the thermo-junctions, both for inverse rate and for differential curves, nothing better is provided than a galvanometer with a pointer moving over an ordinary scale. The entire apparatus thus appears to be suitable only for work of the less delicate or accurate kind, which, however, is of very considerable importance in works practice.

PROBLEMS OF CORAL REEFS.

RECENT work on coral reefs has established firmly the part played by submergence in the production of encircling and barrier reefs. At the same time, such reefs are shown to be based on extensive platforms, from which there is a further descent to oceanic waters. Mr. T. W. Vaughan points out (*Amer. Journ. of Science*, vol. xli., 1916, p. 134) that the banks off Newfoundland, Nova Scotia, and Cape Cod "would furnish proper habitats for reef-building corals did they not lie outside the life-zone of such organisms," while the corresponding plateaus of Florida and the Central American coast support many reefs. He attributes the general overflowing of the marginal land areas in recent geological time to "some diastrophic change in the earth," and is unwilling to accept Glacial control as accounting for all the facts. His paper is an introduction to one on the "Relations of Coral Reefs to Crust Movements in the Fiji Islands," by E. C. Andrews, of Sydney (*ibid.*, p. 135), in which submergence is regarded as essential to the formation of the Great Barrier Reef of Queensland, while the barrier reefs of the Fijis are reviewed as narrow growths rising from land areas that have been recently submerged. Prof. R. A. Daly follows (*ibid.*, p. 153) with a paper on "Problems of the Pacific Islands," and emphasises the presence of platforms one or two miles to one hundred miles in width as bases for the growth of reefs. He also considers the case of Queensland, and the numerous sections given, drawn to scale, are an important contribution to geography. "The problem of the coral reef," he concludes, "is, in essence, the problem of the platform." Mr. T. W. Vaughan, in the Journal of the Washington Academy of Sciences, vol. vi., 1916, p. 53, describes the association of platforms and reefs in the Virgin and Leeward Islands, where the platforms were moulded by marine erosion during Pleistocene time and then submerged, the changes of sea-level thus according with Daly's theory of Glacial control. Readers of NATURE will remember a recent consideration of this theory (vol. xcvii., p. 191).

G. A. J. C.

SPECTRA IN ELECTRIC FIELDS.

SHORTLY after Stark's discovery that certain spectral lines could be split up into two or more components by an electrical field, an account was given in NATURE (May 14, 1914, vol xciii., p. 280), under the title "An Electrical Analogy of the Zeemann Effect," of the experiments of the Italian physicist, Lo Surdo, upon the Balmer series. It was shown by Lo Surdo that the resolution of the four lines in the visible spectrum followed some remarkably simple laws. In a paper, dated December 19, 1915, in the *Rendiconti della R. Accademia dei Lincei*, C. Sonaglia shows that Lo Surdo's laws hold for the first line in the ultra-violet, *i.e.* the fifth of the Balmer series. The total number of components into which the line can be resolved is seven, corresponding to the value of the parameter n in the Balmer formula which gives the line, and the number of components the vibrations of which are perpendicular to the field is five, equal to the number which gives the position of the line in the series.

In the same volume, No. xxiv., are two papers by Rita Brunetti, which detail the results obtained on the helium spectrum by Lo Surdo's method. In the third subsidiary series, in which four lines have been examined, it is found that the number of components into which a line can be resolved is again equal to the value of the parameter n giving the position of the line in the series. For each line there are three unpolarised components, while the number of polarised components is equal to $(n-3)$. In the first subsidiary series only the first member, for which $n=3$, possesses any polarised component; for all the lines of this series the number of unpolarised components of any line is $(n-2)$. It is interesting to notice, when British science is so much under discussion, that the optical apparatus used in all these researches was supplied by an English firm.

We have also received vol. xxiv., 96 pp., of *Atti della fondazione scientifica Cagnola dalla sua Istituzione in Poi*, containing a report by Prof. G. Vanni on the progress and present position of wireless telegraphy and telephony. For choice of material, lucidity, and an interesting style this little volume would be difficult to beat. The literature is brought up to about the end of 1914.

R. S. W.

SCIENCE IN EDUCATION AND INDUSTRY.

LORD CREWE announced at a meeting of the governing body of the Imperial College of Science and Technology on June 30 that it is the intention of the Government to appoint a Special Committee to inquire into the question of the position of science in national education. It is proposed that the Committee, working in close concert with the President of the Board of Education, shall include representatives of pure science, of applications of science to commerce and industry, and also those who are able from general experience to correlate scientific teaching with education as a whole. The Committee will have a close connection with Government, and Lord Crewe himself will be the chairman. The general objects of the Committee will be, broadly speaking, to inquire into the position of science in our educational system, especially in universities and secondary schools. Its duty will be to advise the authorities how to promote the advancement of pure science and also the interest of trades, industries, and professions dependent on the application of science, not neglecting the needs of a liberal education.

These objects are almost identical with those which the British Science Guild and its various important committees have been urging upon public attention for the past ten years, without much practical support from the scientific societies and educational associations, which only awakened to their importance after the war had been upon us for some months. The new Committee is to be connected with the Reconstruction Committee appointed by the Prime Minister in March last to consider and advise upon the problems that will arise on the conclusion of peace, and to co-ordinate the work which has already been done by the Departments in this direction. Lord Crewe said on June 30 that it had been thought wise that the Prime Minister's Reconstruction Committee should undertake the general supervision and review of the changes which might be required in our national system of education, rather than that this inquiry should, as had been recommended, be entrusted to a Royal Commission. The possibility of immediate action by any Department on any point on which necessity for action was proved was a most distinct and substantial gain over what would be possible if the procedure had been by Royal Commission. It was clear that a review of our education generally could not be regarded as strictly one of the subjects of reconstruction after the war, but, on the other hand, the two things could not be disconnected.

Any suggestions or other communications from individuals or organisations bearing upon the inquiries now being undertaken should be addressed to Mr. Vaughan Nash, C.V.O., C.B., Secretary of the Reconstruction Committee, 6A Dean's Yard, Westminster. They will be considered and referred in suitable cases to the Department concerned or to one of the Sub-committees to which particular subjects or groups of subjects have been referred by the Reconstruction Committee.

SCIENCE AND THE BREWING INDUSTRY.[1]

AT the commencement of the period under review, when the author first became definitely associated with the brewing industry, at Burton-on-Trent in 1866, brewing operations were conducted on purely empirical lines, the real nature of the processes involved being unknown. The rational scientific control of these operations which is possible to-day is the outcome of a vast amount of experimental study of brewing problems, and this study has not only extended the bounds of natural science beyond all expectations, but has indirectly conferred incalculable benefits on the human race by its influence on the development of medicine, surgery, and sanitation. The views of Berzelius and Liebig on fermentation were still widely accepted fifty years ago, and the maladies to which beer was subject were attributed to some indefinable transformations of its albuminoid constituents. The true nature of alcoholic fermentation as a normal function of the living yeast cell was elucidated by Pasteur, who rendered immense services to the fermentation industries by his studies on the technology of vinegar, wine (1863–66), and beer (1871–76), bringing to light for the first time the action of bacteria in producing disorders of these beverages. What is not generally recognised is that his later work on infectious diseases and immunisation, which laid the foundation of the subsequent wonderful developments of preventive medicine and hygiene, was the direct outcome of these researches on the fermentation industries, and was in large measure rendered possible by a technique which he acquired therein.

The reactions which take place in the brewer's mash-tun were investigated by O'Sullivan at one of the Burton breweries, from about 1870 onwards, in a series of researches of the first importance, not only to brewing, but to the chemistry of enzyme action. Applying the polarimeter, an instrument rarely used in this country at that time, he studied the action of malt-diastase on starch, demonstrated that the crystallisable sugar formed is not dextrose, but maltose, and studied the quantitative relation of the maltose and dextrin under varying conditions of temperature.

The study of malting processes was stimulated by the transference of the excise tax from malt to beer, in 1881, when certain restrictions on malting operations imposed by the authorities were removed. In a long series of researches the author, in collaboration with G. H. Morris and others, succeeded in bringing to light the principal chemical and morphological changes which go on in the barley grain during the early stages of germination, and laid the foundation of a scientific control of malting processes. He demonstrated that the embryo of the grain is related to the endosperm as a vegetable parasite to its host, that there is no structural connection between the two, and that if the surrounding integuments common to both are removed the embryo can be readily separated from the endosperm and reared into a perfect plant by the application of suitable nutriment. In the germinating barley grain the food reserve in the endosperm is made available for the embryo by means of diastatic, cytatic, and proteolytic enzymes secreted by the epithelial cells of the scutellum of the embryo; these enzymes, projected into the endosperm, dissolve the cell walls and corrode and dissolve the starch granules.

The study of the micro-organisms of fermentation received a fresh impulse, some years after the conclusion of Pasteur's studies on beer, from the work of Emil Chr. Hansen at Copenhagen. He introduced new methods of investigation, distinguished the primary brewers' yeast, *Saccaromyces cerevisiae*, from other types capable of producing secondary changes in beer, and introduced the practice, common on the Continent, of using pure-culture yeasts, produced from a single cell, for brewing.

Many of the problems which arise in connection with the fermentation industries deserve the closest attention of physiologists and pathologists, inasmuch

[1] Abstract of a paper read before the Institute of Brewing, May 8, on "Some Reminiscences of Fifty Years' Experience of the Application of Scientific Method to Brewing Practice," by Dr. Horace T. Brown, F.R.S.

as they present aspects of biochemistry and cell-functioning in a relatively simple form free from many of the complications encountered with higher organisms. One such problem is the activation of enzymes which is sometimes produced by the presence of living cells. The author observed, for instance, that certain kinds of starch granules, capable of resisting indefinitely the action of a highly diastatic liquid in which they were immersed, were readily attacked by the diastase after a trace of yeast had been added. Possibly the explanation is to be sought in the reversible nature of enzyme action and the continuous removal of certain products by the yeast. The subject may perhaps throw some light on the influence of "vitamines" on animal nutrition. The allied problem of symbiosis is exemplified in a relatively simple form by the "amylo-process" employed in certain distilleries at Seclin, in France. In this process the sterilised amylaceous material is saccharified and converted into alcohol and carbon dioxide in one operation by the joint action of a mould fungus which produces diastase, and a yeast which effects fermentation. Another subject which should be of interest to the physiologist relates to the quantitative relation between the reproduction of yeast cells and the supply of oxygen available. The author found that when cells are sparsely distributed through a nutrient liquid the oxygen initially dissolved in the liquid is rapidly absorbed by the cells, and the "oxygen-charge" per cell thus taken up determines the reproductive capacity of the yeast, provided no further oxygen is available. The author gives further examples of the extension of scientific knowledge resulting from the study of brewing problems, and discusses at length some of the more technical matters which still await solution.

THE PLAINS OF NORTHERN INDIA AND THEIR RELATIONSHIP TO THE HIMALAYA MOUNTAINS.[1]

A HUNDRED years ago the accepted idea was that mountain ranges were due to the upward pressure of liquid lava, and that their elevation had been caused by volcanic forces. But when geologists began to study the structure of rocks, they found that mountains had suffered from horizontal compression, which was evident from the folding of strata. This discovery led to the idea that mountains had been elevated, not by vertical forces, but by horizontal forces, which squeezed the rock upward. The wrinkling of the earth's crust into mountains by horizontal forces was explained by the cooling of the earth; this is the well-known contraction theory; the earth's interior is held to cool and to contract, and the outer crust is supposed to get too large for the shrinking core and to wrinkle.

About 1860 the observations of the plumb-line brought to light a most important and totally unexpected fact, namely, that the Himalaya were not exercising an attraction at all commensurate with their bulk.

The plumb-line was observed at Kaliana, 60 miles from the foot of the mountains; the observers found that the Himalaya were exercising no appreciable attraction. By the theory of gravitation the plumb-line ought to be deflected at Kaliana 58 seconds towards the hills. It is not deflected at all; it hangs vertically. This discovery was the first contribution made by geodesy to the study of mountains. The discovery was this, that the Himalaya behaved as if they had no mass, as if they were an empty eggshell; they seemed to be made of rock, and yet they exercised no more attraction than air. From the Kaliana observations Pratt deduced his famous theory of mountain compensation; he explained the Kaliana mystery by assuming that the rocks underlying the mountains must be lighter and less dense than those underlying plains and oceans. The visible mountain masses, he said, are compensated by deficiencies of rock underneath them. This is the theory of mountain compensation. The compensation of the Himalaya is not believed now to be exactly complete and perfect; they seem to be compensated to the extent of about 80 per cent.; their total resultant mass is thus about one-fifth only of their visible mass standing above sea-level. The discovery of mountain compensation struck a blow at all theories which attributed the elevation of mountains to any additional masses that had been pushed in from the sides. The elevation of mountains by subterranean lava squeezed in from the side had to be rejected because it gave to mountains additional mass; the wrinkling of the earth's surface by lateral horizontal forces had to be rejected because it gave to mountains additional mass pushed in from the sides. As the Himalaya possess only one-fifth of their apparent visible mass, I am led to suggest that the principal cause of their elevation has been the vertical expansion of the rocks underlying them, vertical expansion due to physical or chemical change.

Mountains Originate at Great Depths.

A very important work has been that of Mr. Hayford, who has recently discussed the results of the plumb-line at a large number of stations in America. He has confirmed Pratt. Hayford has investigated the depth to which the deficiency of density underlying mountains goes down, and he has found that that depth is between 60 and 90 miles. That is to say, he has shown that the depth of subterranean compensation is very great compared with the height of mountains. The discovery that mountains originate from the great depth of 60 to 90 miles is the second important contribution of geodesy to this study. The first was compensation, the second is great depth.

Southerly Deflections Prevail over the Ganges Plains.

Now let me tell you of the third discovery due to this plumb-line. The survey found that at 60 miles from the hills this plumb-line hung vertically, and Pratt deduced the theory of mountain compensation. But when the survey began to extend their operations, a new phenomenon came to light, which caused great surprise. All over northern India at distances exceeding 70 miles from the hills, this plumb-line was found to hang decisively away from the mountains; here at Lucknow it is deflected 9 seconds to the south. If the Himalaya were simply compensated, this plumb-line should be hanging at Lucknow exactly vertical; if the mountains were not compensated, it should be deflected here about 50 seconds towards the north. But it is deflected 9 seconds towards the south. The observers were astonished to find that at places in sight of Himalayan peaks the plumb-line turned away from the mountain mass; that at Amritsar, in sight of the Dhauladhar snows, it was deflected towards the low Punjab plains; at Bombay it was deflected seawards away from the Western Ghats; on the east coast of India it was deflected seawards away from the Eastern Ghats.

The new lesson to be learnt from the plumb-line is this: a hidden subterranean channel of deficient density must be skirting the mountains of India. Here in North India is a wide zone of deficient density, of crustal attenuation; it is the presence of this zone of deficiency that accounts for the southerly deflection

[1] Abridged from an address to the Indian Science Congress at Lucknow on January 13 by the president, Sir Sidney Burrard, F.R.S.

of the plumb-line. What is the meaning of this zone? How has it come into existence?

If you look at this section the earth's crust in these outer Himalaya has been compressed laterally: of this there is no doubt. The area between the snowy range and the foothills is a zone of crustal compression. And I suggest for your consideration that the Gangetic trough, this zone of deficiency, is a zone of tension in the crust. The crust has been stretched here and attenuated. Here you have compression, and alongside is the tension. The tension is the complement of the compression. I have pointed out that the Himalaya mountains are largely, but not completely, compensated by their underlying deficiencies of density; their compensation is, however, rendered complete by the presence of the Ganges trough; if the Himalayan compression and the Gangetic tension are considered together, it will be found that there is no extra mass.

Hypothesis of a Rift.

I showed you on the evidence of the plumb-line that the Gangetic trough was a zone of crustal attenuation, a zone in which the earth's crust was deficient in density. I then took one step forward and suggested that it was a zone of tension. I will now take another step forward and suggest to you that there has occurred an actual opening in the subcrust, and that the outer crust has fallen in owing to the failure of its foundations. I suggest that the Ganges plains cover a great rift in the earth's crust.

The earth is a cooling globe; an increase of temperature occurs as we descend into mines; and this temperature gradient is a proof that the earth is losing heat by conduction outwards. The discovery of radium has not affected the argument.

The rock composing the crust and subcrust is, however, a bad conductor, and the interior of the earth will not shrink away from its crust, as has been assumed in the contraction theory. The inner core of the earth is, in fact, not losing heat appreciably. The outer shell was the first to lose its heat, then the shell below it, and the subcrust is now losing its heat more quickly than the interior core. As the outer shells contract from cooling they become too small for the core, and they crack. Supposing we had here a great globe of rock, red-hot throughout; how would it cool? Can you imagine it cooling in such a way that the core became too small for the outer shell, and the outer shell became wrinkled? No; the outer shell would cool first, and would crack.

The outer shell of the earth was the first to crack millions of years ago; now a lower shell, the subcrustal shell, is cracking. When a crack occurs in the subcrust, parts of the upper crust fall in.

You will see that this Indus-Ganges trough has the appearance of a crack. And there are reasons for believing that these Himalaya have been split off from this ancient table-land, and have been moved northwards and crumpled up into mountains.

From the Bay of Bengal to the Mediterranean.

Geologists have discovered that the ancient table-land of the Vindhyas and Deccan is a remnant of a much greater table-land that in very early ages included Africa and Arabia. Africa and Arabia and the Deccan table-land are, in fact, fragments of one extensive and ancient continent.

To the west of Karachi we see the Persian Gulf and the plains of the Tigris-Euphrates. The plains of the Tigris-Euphrates are very similar to those of the Ganges: they consist of mud, sand, and sediment lying in a long trough between the ancient table-land of Arabia and the mountains of Persia.

Further west we find the Euphrates trough is continued by the Mediterranean Sea, and the Mediterranean is bounded on the north by the Taurus mountains, by the Balkans, Carpathians, Apennines, and Alps.

Throughout the whole distance from Calcutta to Sicily we see that the old table-land, India-Arabia-Africa, is bounded on the north by a long trough, and that this trough is, in its turn, bounded by the younger mountain ranges from the Himalaya to the Alps. Geologists have discovered that all these mountain ranges were elevated in the same era; they are all of the same age.

I submit for your consideration that the Ganges-Indus-Euphrates-Mediterranean trough is an indication at the earth's surface of a rift in the subcrust.

The whole zone from Java to Sicily has been visited by earthquakes throughout the historic period. And the recent earthquakes in Shillong, Dharmsala, and Messina show that seismic activity is continuing in our time. This is, in fact, one of the zones of the earth along which earthquakes occur most frequently.

The Bombay Coast.

I must now invite your attention to the Bombay coast. From the Tapti to Cape Comorin runs the range of mountains known as the Western Ghats. This range is parallel to the coast of India and about 40 miles inland; it rises suddenly with a steep scarp. The strata are almost as horizontal as when first laid down; they have never been compressed or folded.

The survey has observed the plumb-line at different points along this coast; it is always deflected strongly towards the sea. To the west of Bombay and Mangalore there is the deep sea; and to the east there is a massive range more than 4000 ft. high; yet the plumb-line will hang seawards. If the Western Ghats possessed the mass which they appear to possess, and which the Suess school ascribes to them, then the Bombay plumb-line should be deflected 15 seconds towards them. If, on the other hand, the Western Ghats are compensated by deficiencies of mass underlying them in accordance with the compensation theories of Pratt and Hayford, then the plumb-line should hang vertically at Bombay. But the plumb-line takes neither of these courses; it hangs towards the sea. We have been puzzled for years by the plumb-line at Bombay; we used to think that the rock under the ocean must be so dense and heavy that it was able to pull the plumb-lines towards the sea. Major Cowie, however, observed in the south of Kathiawar, and found that the plumb-line here had a strong landward deflection. The seaward deflections occur throughout the Bombay coast, but not round Kathiawar. It is only quite recently that we have realised we have at Bombay the same phenomenon as at Lucknow.

In northern India the plumb-line will persist in hanging away from the visible mountains, and at Bombay it takes the same course, and when I consider its constant seaward deflection I can only suggest to you that a crack in the subcrust has extended from Cape Comorin to Cambay, and that as this crack has occurred the Western Ghats have been elevated. The crack has been filled by masses of fallen rock and by alluvial deposits brought down by rivers.

Geologists have shown that this range consists, from latitude 20° to 16°, of the lavas of the Deccan, comparatively recent rocks, whilst from latitude 16° to 8° the range consists of ancient metamorphic rocks. The rocks of the northern part of the range are of a different age and structure and origin from those of the southern.

Nevertheless, geodesists contend that this is one and

the same range; the rocks composing it have had nothing to do with its elevation. The Western Ghats have been elevated, after the Deccan lavas had become solidified, into surface rocks. Their elevation took place in the Tertiary age.

The Depth of the Gangetic Rift.

In considering the depth of the Gangetic rift we must appeal, first, to geodesy, and then to seismology. Now geodesy tells us that the compensation of the Himalaya (*i.e.* the root of the Himalaya) extends downwards to a great depth. I regard the Gangetic plains and the Himalayan range to be the two parts of one whole; I believe that they have originated together, and if the depth of Himalayan compensation extends down to 60 miles, then I think that the Gangetic rift may extend down to that depth also.

Now let us turn to seismology; seismologists are able to form rough estimates of the depths of earthquakes. In the Dharmsala earthquake Middlemiss estimated its depth to be between 12 and 40 miles. Middlemiss's maximum value is not very different from the geodetic value.

It is an interesting question to consider whether a fissure in rocks could extend downwards to a great depth. From a place near the Indus in Kashmir it is possible to see a continuous wall of rock 4 miles in height, on the flank of Nanga Parbat. Mount Everest stands erect $5\frac{1}{2}$ miles above sea-level; its summit stands firm and rigid 11 miles above the depths of the Bay of Bengal. We have, therefore, evidence that the materials of the crust are strong enough to admit of the continued existence of great differences in altitude.

But Mount Everest is standing in air, whereas a crack in the subcrust becomes filled with rocks falling in and with fluid rock magma from below; and the walls of the crack thus get a support that Mount Everest does not possess. It seems to me quite possible that a crack such as I have described may have extended down to a depth of 60 miles by successive fractures at increasing depths, the opening being filled by falling material.

Internal Causes of Mountain Elevation.

I have shown you how zones of subsidence in the crust are bordered by mountains, and I have now to discuss the relationship of subsidence to elevation, of troughs to mountains. The Red Sea is a zone of fracture, and it is bordered on each side by a zone of elevation. But along the Bombay coast the zone of subsidence is bordered only on the one side by a zone of elevation. The subcrustal crack from Surat to Cape Comorin has been accompanied by a vertical uplift of the Ghats, and I suggest for your consideration that the vertical force which elevated the Ghats was the expansion of the underlying rock due to physical or chemical change.

Mr. Hayden informs me that the specific gravity of the rock composing the Neilgherries varies from 2·67 to 3·03—that is, 14 per cent.—and that the rock of the Hazaribagh plateau varies from 2·5 to 3·1—24 per cent.

The Western Ghats appear to have risen about 4000 ft. Now we know that the Western Ghats are largely compensated by underlying deficiency of density; if the compensation of the Western Ghats extends downwards to a depth of 60 miles, then an expansion of 2 per cent. would be more than sufficient to account for the elevation of the Ghats. Mr. Hayden finds variations of 14 and of 24 per cent. in the densities of surface rocks, and yet an expansion of only 2 per cent. would account for both the elevation and the compensation of the Ghats.

The heterogeneous rocks composing the earth's crust are continually undergoing changes of structure, known to geologists as metamorphism. At a depth of 30 miles the temperature is sufficiently high to melt all known rocks; but increase of pressure raises the melting point, and the increase of pressure underground may be sufficiently great to counteract the effects of the increase of temperature. So that at a depth of even 60 miles rocks may still be solid and rigid, as geodesy leads us to believe they are.

The main ranges of the Himalaya are composed of granite; this granite has protruded upwards from below. I suggest that the protrusion of granite is due to expansion of rocks in the subcrust. The great Himalayan range is 5 miles high, and the compensation of this range—that is, its underlying deficiency of density—is estimated to extend downwards to a depth of perhaps 75 miles. An underground expansion of 7 per cent. would be sufficient to account for the elevation of the Himalaya.

Many of the faults which intersect the Himalaya may, I think, be ascribed to the shearing which must have ensued when certain areas of the crust were forced vertically upwards by the metamorphism of subcrustal rock. Many distortions of surface strata may be ascribed to local variations in the vertical expansion of deep-seated rocks.

The peculiar sinuous curve of the northern Tibetan border, concave on the east, convex on the west, is reproduced in the north of Persia, and again in the Carpathians. The Persian ranges all have a trend from south-east to north-west, except that the Caspian subsidence seems to have pushed rudely in from the north and forced the northern range into a sinuous curve. It is significant that at the point of the Caspian push stands the peak of Demavend, the highest point in all Persia. *Elevation is the companion of subsidence.*

The conclusions which I have ventured to submit to this meeting may be summarised as follows:—

(1) The fundamental cause of both elevation and subsidence is the occurrence of a crack in the subcrust.

(2) Mountains are compensated by underlying deficiencies of matter.

(3) Mountains have risen out of the crust from a great depth, possibly 60 miles.

(4) Mountains owe their elevation mainly to the vertical expansion of subjacent rock.

I have now had the great privilege of placing certain problems before you. My endeavour has been to point out to this congress, and especially to its younger members, the many scientific secrets that are lying hidden under the plains of northern India.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—No honorary degrees were conferred at this year's Encænia, but on June 29 Mr. Douglas W. Freshfield received the honorary degree of D.C.L. The Public Orator, in presenting Mr. Freshfield, laid especial stress on his advocacy of the claims of geography for full recognition among university studies. He spoke also of Mr. Freshfield's eminence as a mountaineer, of his personal devotion to the theory and practice of geographical science, and of his achievements as a man of letters.

SHEFFIELD.—In connection with the new department of glass technology the University has instituted a diploma in the subject. The course of study will cover three years, but candidates who have spent at least two years in the glass industry may be exempted from attendance in the first year's course under certain conditions. The last two years' study will be devoted almost entirely to the chemistry, physics, and

technology of glass, with a certain amount of instruction in engineering principles and mechanical drawing.

Three scholarships, of the approximate value of 50*l.* each, are offered by the *Common Cause* (the organ of the National Union of Women's Suffrage Societies) to women who wish to qualify for positions as industrial chemists. Applications must be made not later than the morning of July 17 to the scholarship secretary, the *Common Cause,* 14 Great Smith Street, London, S.W., from whom further particulars can be obtained.

Dr. A. H. Graves, who during the year 1914–1915 was engaged in botanical research at the laboratory of Prof. V. H. Blackman, Imperial College of Science and Technology, London, has been appointed associate professor of biology in the new Connecticut College for Women at New London, Connecticut, U.S.A. Dr. Graves was formerly assistant professor of botany in the Sheffield Scientific School of Yale University, and instructor in forest botany in the Yale Forest School.

The eighth annual meeting and conference of the Secondary Schools Association will be held at Caxton Hall, Westminster, S.W., on Wednesday, July 12, at 2 o'clock p.m. Sir Philip Magnus, M.P., will preside. Two papers will be read on this occasion, namely, (1) "Scientific Habits and Knowledge," by Mr. F. Beames, senior science master at Bristol Grammar School, and (2) "Scientific Method in Education," by Mr. S. E. Brown, headmaster of the Liverpool Collegiate School.

Regimental care committees and relatives and friends of British prisoners of war will do them a good service by bringing to the notice of the interned, in their letters to them, the fact that if they are desirous of carrying on serious reading they can obtain, free of charge, educational books on almost any subject by writing to Mr. A. T. Davies at the Board of Education, Whitehall, London, S.W. To facilitate the dispatch of parcels of books and, if possible, the organisation of an educational library in every camp, all applications for books should, as a rule, be sent through, or endorsed by, the senior, or other responsible, British officer *or* N.C.O. in the camp. Where for any reason (which should be stated in the application) this course is impracticable, requests from individual prisoners will be acceded to so far as possible.

The General Education Board of the United States announces that grants amounting to 158,000*l.* were made at its annual spring meeting. The largest grant was one of 50,000*l.* for the medical department of Washington University, St. Louis, Missouri. This gift makes 200,000*l.* appropriated by the General Education Board to this institution towards a total of 300,000*l.* for the purpose of placing the teaching of medicine, surgery, and pediatrics on the so-called full-time basis. Including the appropriations now made, the General Education Board has, since its organisation in 1902, made grants amounting to 3,677,400*l.* This amount was either appropriated outright or towards total funds to be raised amounting in all to 12,897,400*l.* Of the grants made during this period, about 600,000*l.* was for medical schools, 2,500,000*l.* for universities and colleges, 20,000*l.* for further prosecution of educational researches, 180,000*l.* for colleges and schools for negroes, 60,000*l.* for professors of secondary education, and 20,000*l.* for farm demonstration work.

The Board of Education has issued a circular dealing with several points in connection with the education services and military service. Teachers, full-time students in public schools of various grades, and education officials who are not passed as fit for general service are not to be called up without reference to the War Office, which will consult with the Board of Education. The procedure now applicable in the case of attested teachers and officials fit for general service may also be used in the case of unattested as well as of attested, but reference is in future to be made to the War Office (not the Board of Education as heretofore). Full-time students fit for general service are not for the present to be called up until they attain the age of eighteen; but the Army Council may terminate this arrangement after July 31. The Army Council, on grounds of public interest, will consider applications endorsed by the Board of Education for the postponement of military service in the case of specially selected students of science or technology. The applications must be limited to research students or post-graduate students, and other students who are likely to attain a standard equivalent to first- or second-class honours in courses leading to degrees. Applications on behalf of such students are to be made in the first instance to the Board of Education by the authorities of the universities and colleges concerned.

SOCIETIES AND ACADEMIES.

London.

Physical Society, June 16.—Prof. G. W. O. Howe in the chair.—Capt. C. E. S. **Phillips**: Experiments with mercury jet interrupters. The paper describes an experimental attempt to ascertain the form of the mercury column issuing from a hole in the side of a rotating drum, that is continuously supplied with mercury by centrifugal action. Incidentally a new form of interrupter is introduced, in which the interior is visible through a window in the lid. Experiments with various forms of orifice are described, and it is pointed out that the issuing stream is only slightly affected by this means. An explanation is given of the fact that a vertical slit orifice will not produce a ribbon of mercury, and that no matter how much the diameter of the orifice is increased beyond about 2 mm., the cross section of the mercury column remains unaltered. A method is described, however, by which a much larger stream of mercury can be obtained from the rotating drum, if necessary.—G. D. **West**: A method of measuring the pressure of light by means of thin metal foil. Part ii. The pressure of the radiation emitted by a carbon filament lamp, at a distance of a few centimetres, is sufficient to cause a microscopically measurable deflection of the end of a strip of gold or aluminium foil, suspended in a closed test tube. By this means the radiation pressure may be measured, and the results may be checked by a comparison with the energy density of the radiation, as deduced from the initial rate of rise of temperature of an exposed blackened copper plate. In a previous paper experiments were carried out in atmospheres of air and hydrogen, and at pressures extending from 76 cm. to 1 cm. of mercury. Under certain conditions it was found possible to obtain satisfactory results. The present paper deals with experiments at pressures from 1 cm. of mercury down to the highest exhaustions that could be reached. Experiments on the pressure of light may thus be advantageously carried out at the highest vacua obtainable, or at pressures as far above 0·002 cm. of mercury as convection currents will permit. The latter alternative is the easier, and leads to more consistent results.—Edith **Humphrey** and E. **Hatschek**: The viscosity of

suspensions of rigid particles at different rates of shear. This investigation was undertaken with a view of testing the Einstein-Hatschek formula at variable rates of shear. According to this formula the viscosity of a suspension of rigid spherical particles grows in linear ratio with the aggregate volume of suspended particles, and is independent of their size, so long as the latter conforms to Stokes's formula. The suspension chosen was one of rice starch of 0·003 mm., and less, diameter, in a mixture of carbon tetrachloride and toluene having the same specific gravity. The results of the investigation are:—(1) The viscosity of a suspension is a function of the rate of shear, and increases as the latter decreases, the difference being more marked at higher concentrations; (2) for all rates of shear the viscosity of the suspension increases more rapidly than the aggregate volume of suspended matter; (3) for any one rate of shear the relative viscosity of a suspension, *i.e.* its absolute viscosity divided by the absolute viscosity of the medium at the same rate of shear, also increases more rapidly than the percentage of suspended matter, the divergence from the linear increase demanded by the formula becoming less as the rate of shear becomes greater, so that a linear law may possibly hold good at rates of shear higher than those attainable in the present apparatus without turbulence. The general conclusion is that the assumption on which the Einstein-Hatschek formula is based, viz. non-interference between adjoining particles, is not tenable in the case of suspensions containing between 2 and 6 per cent. of suspended matter.—Dr. A. **Griffiths** and others: A correction of some work on diffusion. When salt diffuses through water, in general there must be a movement of the water due to volume-changes associated with variations in concentration. In the papers to which the recalculation refers reference was made to the velocity of the liquid or solution; but what was meant by the velocity of the liquid was not explained. The author now deals with the velocity of the water-component of the solution, to which a clear mathematical meaning can be given.

Royal Microscopical Society, June 21.—Mr. E. Heron-Allen, president, in the chair.—Miss G. **Lister**: The life-history of Mycetozoa, with special reference to Ceratiomyxa. The author referred to the work of Dr. Jahn, of the Berlin University, proving that the amœbulæ produced by division of the swarm-spores united in pairs as gametes to produce zygotes, from which the plasmodia grew. The nuclei of the zygotes had twice as many chromosomes as the nuclei of the gametes. In Ceratiomyxa Dr. Jahn was the first to observe the division of nuclei in the young sporophores prior to spore-formation; this was found to be a reduction division, and took place during the "network" stage of the maturing sporophore. To illustrate these observations, lantern slides taken from the preparations lent by Dr. Jahn were shown on the screen, as well as a series of slides showing the more striking forms of sporangia met with among the Mycetozoa.

Paris.

Academy of Sciences, June 19.—M. Camille Jordan in the chair.—G. **Bigourdan**: Honoré Gaultier and some confusion which has arisen concerning him.—G. **Bigourdan**: The propagation of sound to a great distance in the open air. It is known that intense sounds, produced by explosions, are not regularly propagated round the source, but that there are zones of silence and zones in which the sound is heard. The cannonade at the front offers an opportunity for the experimental study of this phenomenon, and a plan is outlined for its systematic study.—H. **Le Chatelier**: The maximum solubility of calcium sulphate. A reply to some criticisms of M. Colson.—A. **Chauveau**: The precautions necessary in the study of tuberculosis in persons employed in Parisian wine-bars. A reply to the views expressed by M. Landowzy. The author maintains that tuberculous infection is independent of alcoholism.—A. **Verschaffel**: A new method for the study of the graduations of a circle.—R. **Garnier**: Study of the general integral of equation (VI.) of M. Painlevé in the neighbourhood of its transcendant singularities.—E. **Baticle**: The pressure exerted by a pulverulent mass with a free plane surface on a sustaining wall.—S. **Posternak**: The isomers $T_{7\cdot8}$ and $T_{5\cdot6}$ of stearolic acid. Only four of the sixteen possible isomers of the normal chain acetylenic acids, $C_{18}H_{32}O_2$, have up to the present been described. The preparation and properties of two additional isomers are described in the present paper.—M. **Dalloni**: The marine Bartonian in the Pyrenees.—M. **de Lamothe**: The ancient outlines of the coast of the basin of the Somme, and their concordance with those of the western Mediterranean.—E. **Belot**: The asymmetry of the Pacific, the law of the antipodes, and the general profound forms of the earth in the hypothesis of a primitive southern deluge.—B. **Galitzine**: The localisation of the epicentre of an earthquake. The author recently developed a method for fixing the position of the epicentre of an earthquake from observations at a single station. Since this method has been adversely criticised, the records at the Pulkovo Observatory have been examined, and in 18 per cent. of the shocks registered the epicentre could be localised.—G. **Bourguignon**: The measurement of resistances by discharges of condensers, using a sensitive milliammeter as a ballistic galvanometer. For physiological purposes, the method gives a maximum error of 4 per cent.—A. Ch. **Hollande**: The anti-coagulating power of acid aniline dyes towards albuminoid materials. Acid aniline dyes combine with albuminoids forming coloured acido-albumens; these are not coagulated at 100° C., nor even after twenty minutes in an autoclave at 120° C.—M. **Steppanides**: A colorimetric method used by the Romans for testing drinking water. Claim for priority against M. Trillat.

Washington, D.C.

National Academy of Sciences, May (Proceedings No. 5, vol. ii.).—W. **Hull** and Marion **Rice**: The high-frequency spectrum of tungsten. The authors show two photographs of the spectrum of X-rays taken in the usual manner in a rock-salt crystal. They also give figures which show the ionisation current as a function of the angle of incidence. A comparison with previous results obtained by others is sketched.—R. L. **Moore**: The foundations of plane analysis situs. As point, limit-point, and regions (of certain types) are fundamental in analysis situs, the author has set up two systems of postulates for plane analysis situs based upon these notions; each set is sufficient for a considerable body of theorems.—E. B. **Wilson** and C. L. E. **Moore**: A general theory of surfaces. Continuing the work of Kommerell, E. Levi, and Segre, a theory of two-dimensional surfaces in *n*-dimensional space is developed by the method of analysis outlined by Ricci in his absolute differential calculus.—J. C. **Hunsaker**: Dynamical stability of aeroplanes. A comparative detailed study of two aeroplanes, one a standard military tractor, the other designed for inherent stability, is made for the purpose of reaching general conclusions of a practical nature with respect to aeroplane design. It appears that inherent stability (except at low speed) can be obtained by careful design without departing seriously from the standard type now in use.—W. M. **Davis**: Clift islands in the coral seas. The

author extends his former work on "The Origin of Corals Reefs" to include the explanation of the clifts of exceptional reef-encircled islands, of which no adequate explanation has previously been given.—C. D. **Perrine**: Some relations between the proper motions, radial velocities, and magnitudes of stars of Classes B and A. The velocity distribution of classes B–B5 and A differ from the distributions found for the F, G, K, and M classes by Kapteyn and Adams.—C. D. **Perrine**: Asymmetry in the proper motions and radial velocities of stars of Class B and their possible relation to a motion of rotation. Stars of Class B show differences in the proper motions in the two regions of the Milky Way at right angles to the direction of solar motion; the differences appear to be best explained by a general motion of rotation of the system of stars in a retrograde direction about an axis perpendicular to the Milky Way.—E. B. **Wilson**: Theory of an aeroplane encountering gusts. The longitudinal motion of an aeroplane encountering head-on, vertical, or rotary gusts is discussed by the method of small oscillations. An inherently stable machine striking a head gust of J ft. per second soars to an altitude of about $4\frac{1}{2}$ J ft. above its initial level, and, after executing oscillations, remains about $3\frac{1}{2}$ J ft. above the original level.—T. **Michelson**: Terms of relationship and social organisation. From the point of view of Algonquian tribes terms of relationship are linguistic and disseminative phenomena, though in other cases they may be primarily psychological and sociological.

BOOKS RECEIVED.

Department of the Interior. Bureau of Education. Report of the Commissioner of Education for the year ended June 30, 1915. Vol. i. Pp. xx+780. (Washington: Government Printing Office.)

Library of Congress. Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds, for the fiscal year ending June 30, 1915. Pp. 231. (Washington: Government Printing Office.)

Smithsonian Institution. U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the year ending June 30, 1915. Pp. 215. (Washington: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. Thirty-sixth Annual Report of the Director of the U.S. Geological Survey for the fiscal year ended June 30, 1915. (Washington: Government Printing Office.)

Report on the Progress of Agriculture in India for 1914–15. Pp. ii+82. (Calcutta: Superintendent, Government Printing.) 6*d.*

Government of India. Bureau of Education. Indian Education in 1914–15. Pp. 77. (Calcutta: Superintendent, Government Printing.) 3*s.*

Jahrbuch des Norwegischen Meteorologischen Instituts für 1915. Pp. xi+140. (Kristiania: Gröndahl and Son.)

Nedbøriagttagelser I Norge utgit av Det Norske Meteorologiske Institut. Pp. xi+66. (Kristiania: Aschehoug and Co.) Kr.3.00.

The Heat Treatment of Tool Steel. By H. Brearley. Second edition. Pp. xv+223. (London: Longmans and Co.) 10*s.* 6*d.* net.

Macmillan's Geographical Exercise Books. V. Asia and Australasia, with questions by B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 7*d.*

Theory of Errors and Least Squares. By Le Roy D. Weld. Pp. xii+190. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5*s.* 6*d.* net.

Vinegar: Its Manufacture and Examination. By C. A. Mitchell. Pp. xvi+201. (London: C. Griffin and Co., Ltd.) 8*s.* 6*d.* net.

Department of Commerce. U.S. Coast and Geodetic Survey. Serial No. 21: Results of Observations made at the U.S. Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, 1913 and 1914. Pp. 105. (Washington: Government Printing Office.)

Summary Report of the Geological Survey, Department of Mines, for the Calendar Year 1915. Pp. viii+307. (Ottawa: J. de L. Taché.) 15 cents.

Canada. Department of Mines. Geological Survey. Memoir 79: Ore Deposits of the Beaverdell Map Area. By L. Reinecke. Pp. v+178. (Ottawa: Government Printing Bureau.)

City and Guilds of London Institute. Report of the Council to the Members of the Institute. Pp. xlv+112. (London: Gresham College.)

DIARY OF SOCIETIES.

FRIDAY, JULY 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Geology and Scenery of the Cardiff District: Prof. T. F. Sibly.

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Editorial and Publishing Offices:
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THURSDAY, JULY 13, 1916.

BRITISH MARINE ANNELIDS.

A Monograph of the British Marine Annelids. Vol. iii., part i. Text. Polychæta: Opheliidæ to Ammocharidæ. By Prof. W. C. McIntosh. Pp. viii+368. Also vol. iii., part ii. Plates lxxxviii–cxi. (London: Dulau and Co., Ltd., 1915.) Price 25*s*. net each volume.

THE first part of the first volume of this monograph of British Annelids dealt with the Nemertine worms. The second part of the first volume, the two parts of the second volume, and now the third volume are devoted to the Chætopoda, and still the great work is incomplete. At least one more volume will be required before the order Polychæta is finished.

The third volume includes those families that were grouped together by Benham in the sub-orders Spioniformia, Capitelliformia, and Scoleciformia, together with the family Cirratulidæ of the sub-order Terebelliformia.

The author has not adopted in his monograph any system of grouping the families into sub-orders such as that suggested by Benham, and it is rather awkward for the zoologist who is not a specialist in the Chætopoda and does not know the sequence of families which Prof. McIntosh employs that he has no guide to the position in the three volumes of any family he wishes to study, nor a list of those that have still to be described.

No doubt the author will prepare a tabular statement of the classification of the order for the last volume, but it would have been a great convenience if he had included in each part a list of all the families arranged in the order of their treatment.

We make this comment in the first place because the monograph is on a much higher plane than many of the systematic treatises on zoology with which we are acquainted, and it is important in the interests of science that everything should be done to facilitate its use.

The present volume includes many of the most important of the marine worms, such as the Arenicola (or lug-worm of the fisherman), the phosphorescent Chætopterus, the Spionidæ, the rock-boring Polydora, and the morphologically interesting forms Magelona and Capitella. In studying the chapters on these important worms the reader must be impressed not only by the vast amount of labour and learning bestowed upon their systematic treatment, but also by the author's generous appreciation of the anatomical, physiological, and embryological knowledge concerning them that has accumulated during recent years. It is clearly shown on every page that infinite pains have been taken with the tedious but necessary and valuable work of completing the lists of synonyms and references to species; but intimate knowledge and life-long research have also been employed in summarising what is known of the morphology of the species described. The monograph stands, therefore, as an important contribution to our general knowledge of the order as a whole, as well as a descriptive catalogue of the species that inhabit the British sea area. It is a standard work of the highest importance, and we may be proud of it as a product of British science.

It is unfortunate that our final judgment of the illustrations must be suspended. Six of the twenty-four plates that illustrate part ii. of this volume were to have been issued in colours, but in consequence of the war they have not yet been delivered, and to prevent further delay in publication uncoloured copies have been substituted for them. This is undoubtedly a serious misfortune, and we may cordially extend to Prof. McIntosh our good wishes that in the coming times of peace the coloured plates may be recovered. In the meantime, however, we may say that, apart from this drawback, the illustrations are at least equal to the very high standard attained by those of the earlier volumes, and add immensely to the value of the monograph.

S. J. H.

COLLOIDAL SOLUTIONS.

The Physical Properties of Colloidal Solutions. By Prof. E. F. Burton. Pp. vii+200. (London: Longmans, Green, and Co., 1916.) Price 6*s*. net.

THIS work forms one of the series of monographs on physics edited by Sir J. J. Thomson, and it is perhaps natural that the author should have practically confined himself to discussing that class of colloidal solutions which has so far proved amenable to quantitative and mathematical investigation—the class known as suspensoids. The treatment of the emulsoids is very brief and inadequate, an omission all the more striking as the author several times insists on the importance of colloidal physics to the arts and to biology and physiology, the former of which are largely, and the latter exclusively, concerned with emulsoids.

Within these limits, however, the treatment is full and very clear. The chapter on preparation and classification gives all that is necessary in a small compass. In that on the ultramicroscope the author has gone a good deal further than is usual, and perhaps necessary, by including a brief account of the principal theories of image formation and resolving power. The chapters dealing with the theory of the Brownian movement—to the physicist the crowning achievement of colloidal science—are admirable and give the best historical account, as well as the clearest presentation, of the mathematical work of Einstein, v. Smoluchowski, Langevin, and Perrin at present available in any text-book. The optical properties are also treated with unusual fulness, while the electrical ones receive ample, but not excessive, attention. The frank confession—which probably only one of the best-known workers in this much-tilled field can afford to make—that the stability of sols is still a puzzle is to be welcomed. Adsorption is only touched upon as bearing upon electrolyte coagulation, and the statement that the adsorption isotherm

approaches a line parallel to the C-axis "asymptotically" is certainly surprising, if Freundlich's equation is accepted as correct.

An agreeable feature of the book is the amount of space devoted to presenting the historical development of different branches of the subject, many quotations from the original papers of pioneer workers being given. In this connection the author fixes 1750 as the earliest date at which gold sols had been obtained by reduction. "Aurum potabile," however—a red liquid prepared by reducing gold chloride with oil of rosemary and undoubtedly a gold sol—had considerable vogue as a medicine much before that time, being mentioned, *e.g.*, by John Evelyn in his diary under the date June 27, 1653.

The references to literature—given at the end of each chapter—are copious, and names and subject matter are well indexed. The book may be thoroughly recommended to the large class of students to whom a knowledge of colloidal science is becoming increasingly necessary; to cover the whole field it should be supplemented by a volume dealing with emulsoid sols and gels, which latter in particular are systems quite as fascinating, and certainly as important, as sols.

MATHEMATICAL PAPERS AND ADDRESSES.

(1) *Proceedings of the London Mathematical Society*. Second Series. Vol. xiv. Pp. xxxviii + 480. (London: F. Hodgson, 1915.) Price 25*s*.

(2) *Four Lectures on Mathematics*. Delivered at Columbia University in 1911 by Prof. J. Hadamard. Pp. v + 52. (New York: Columbia University Press, 1915.)

(1) A VOLUME of the L.M.S. Proceedings is not only a permanent record of achievement. At its first appearance it is a useful index of the state of English mathematics at the time; and it also, from year to year, suggests the appearance of new stars in the mathematical firmament. It may be not without significance that, in the present volume, there is a first contribution (we believe) by a Japanese gentleman, and another by an Indian fellow-subject. Unless we are greatly mistaken, or unkindly fate should intervene, Mr. S. Ramanujan is likely to become an arithmetician of the first rank. At any rate, his paper on highly composite numbers is original, profound, and ingenious, and shows complete mastery of the new methods and notation inaugurated by Landau. Mr. Tadahiko Kubota provides one of the two papers in the volume which have any claim to be called geometrical, and of these it is the more truly such. Under certain assumptions, most of which are explicit, or nearly so, he proves the following theorem: "If a closed convex surface be cut by every pencil of parallel planes in homothetic curves, it is an ellipsoid." The method of proof consists mainly in showing that such a surface defines a polar field precisely similar to that which is determined by an ellipsoid. The comparative simplicity of the demonstration is very remarkable.

The other geometrical paper, by Mr. E. H. Neville, was suggested by the racecourse puzzle of covering a circle by a set of five circular discs. Unfortunately, the solution depends upon four simultaneous trigonometrical equations, and as these are treated analytically, the paper has only a tinge of geometrical theory. Once more we must express our regret that English mathematics is so predominatingly analytical. Cannot someone, for instance, give us a truly geometrical theory of Poncelet's poristic polygons, or of Staude's thread-constructions for conicoids?

The other papers cover a wide range, from group-theory at one end (Prof. Burnside) to tide-theory at the other (Prof. Larmor). One of the most important, in our opinion, is that of Mr. and Mrs. W. H. Young on the reduction of sets of intervals—one of the many notable extensions of the famous Heine-Borel theorem. It would be foolish to try to give a detailed estimate of all the twenty-six papers.

Prof. Love's address on mathematical research is bright as well as stimulating, and many of his crisp sayings deserve the most careful attention; for example, his remarks on exact solutions of physical problems, on the difficulty of applying the general theory of ordinary linear differential equations, on "curiosity," on the danger of being overwhelmed by the mass of literature, and so on. We wish we could agree with his unqualified assertion that "text-books and treatises include always later additions to knowledge"; perhaps he regards productions that do not conform to this statement as mere samples of those "books that are no books" to which Lamb refers. Lastly, we may note that Prof. Love attaches due importance to mathematical style in composition. This is too often neglected; simplicity, clearness, and appropriate notation ought, at any rate, to be aimed at with all possible diligence. We rejoice, too, that in this connection he boldly and truly says that a mathematical book or paper is (or should be) a work of art.

(2) The United States have been pioneers in the practice, now common, of inviting eminent foreigners to give occasional lectures, or courses of lectures, on their chosen subject; we do not refer to lectures or addresses on ceremonial occasions. Prof. J. Hadamard is renowned for his original researches in function-theory; in the present short course of four lectures he deals with the bearings on physics of various types of equations (differential, integral, integro-differential), and, in a minor degree, of topology (*analysis situs*). It is needless to say that they are highly suggestive and valuable; their defect, such as it is, is that in trying to cover a wide field the author is obliged to be very concise, and in some cases this leads to obscurity. As an example of what we mean, take p. 34. Substantially (unless we mistake the author's intention), Prof. Hadamard wishes to point out that physical problems which have the same analytical solution lead to different interpretations of the solution,

and that in drawing our conclusions we must attend to the circumstances of the case. The example he chooses is the dynamical one, where we have a Lagrangian system in generalised co-ordinates, reducible to $2T=m(\dot{x}^2+\dot{y}^2)$, $U=c$, where m, c are constants. One such system is that of a particle under no forces; another is a gyrostat with two degrees of freedom, for which x, y are angular co-ordinates (and therefore periodic, so far as the actual motion is concerned). All this is plain enough; but when the lecturer says, "The assemblage of all possible positions of system (2) can be represented not on a plane, but on the surface of an anchor-ring," the reader may feel confused, especially since to trace the path of any particular point of the gyrostat we must introduce *additional* co-ordinates.

Prof. Hadamard emphasises (p. 17) the work of Poincaré on ordinary differential equations, especially in the *Journ. de Math.*, 1887 (on the shape of curves defined by differential equations). He also (p. 33) protests, we are glad to see, against the over-analytical drift of current mathematics. In his dealing with Green's theorem we regret to see no reference to Mr. J. Dougall. Doubtless this is due to ignorance; but Mr. Dougall's work is masterly and in the true spirit of Green, and it is most unfortunate that it is practically buried in a periodical which (for no fault of its own) has no very wide circulation.

The text, on the whole, seems to be a satisfactory rendering of the French original; "admit" for "allow" or "assume," "effectively" for "as a matter of fact," etc., are such common errors that they are unlikely to lead to mistakes on the part of the reader. The typography is unusually good, and a credit to the Columbia University Press. G. B. M.

W. B. TEGETMEIER.

A Veteran Naturalist: being the Life and Work of W. B. Tegetmeier. By E. W. Richardson. With an introduction by the late Sir Walter Gilbey, Bart. Pp. xxiv+232. (London: Witherby and Co., 1916.) Price 10*s*. net.

THIS is a pleasantly written sketch of the life of a versatile naturalist, of strongly marked individuality, whose name will be for long associated with poultry and pheasants, homing pigeons and bees, to the study of which he made notable contributions. W. B. Tegetmeier (1816–1912) was the son of a doctor and also the grandson; and he was himself more or less of a medical student and apprentice for ten years (1831–41). But an inborn attraction to birds and beasts, a recoil from humdrum routine, and a conspicuous absence of a bedside manner (as he said himself) led him to teaching for a short time, and to journalism for a very long time, and to a life of fruitful zoological inquiry, especially along economic lines.

The story of Mr. Tegetmeier's life, which Mr. E. W. Richardson, a son-in-law, has told with directness and enthusiasm, shows how a man of talent and industry, honesty and courage, wrung a livelihood out of unpromising circumstances, and won the respect and affection of all worthy men who knew him. For half a century Mr. Tegetmeier was in charge of the poultry and pigeon department of the *Field*, and for a score of years he wrote regularly for the *Queen*. As a consultant and expert judge he was incessantly busy in connection with pheasants, poultry, pigeons, and the like, and did important work in setting a high standard of accuracy, both of statement and action.

Introduced by Yarrell to Darwin in 1855, he enjoyed the master-naturalist's friendship for twenty-five years, and the value that Darwin put upon his observations is well known. It may be recalled that Tegetmeier, who was a convinced evolutionist, had strong suspicions as to the theory of sexual selection, pointing out, for example, that disfigured game-cocks were accepted just as thoroughly as the dandiest of their rivals. In connection with the Savage Club, of which he was one of the founders, and in the pursuit of various hobbies, Mr. Tegetmeier allowed himself relaxation, but it appears that he never went for a walk or took a holiday. He was absorbed in his work, almost always thoroughly enjoying it, and he lived for nearly a century.

Mr. Richardson tells us of Tegetmeier's early "observation-hives," and how he once took a swarm of bees from over the door of the Gaiety Theatre, to the fearful delight of the spectators; how he was interested in school "nature-study" when the very idea was novel; of his numerous breeding experiments when neither Darwin nor he knew of Mendel; of his realisation of the importance of homing pigeons in ante-"wireless" days; of his endless post-mortems, which sometimes rather embarrassed his household; of his interesting chronicling of the metamorphosis of the axolotl; and of much more besides, not forgetting his anti-feminist prejudices. The delightful biography is in its mood harmonious with the sincerity of one who never suffered humbugs gladly, and the numerous interesting illustrations increase the impression of picturesqueness which marked the man himself. Of a sceptical and agnostic mood, he never disparaged religion; and when Mr. Richardson once asked him if he denied the existence of God, he replied: "My boy, how could I, when every leaf on every tree proclaims its Maker, and is a living witness to the power, wisdom, and providence of the Creator of the leaf and of life and of all things?"

OUR BOOKSHELF.

Modes of Research in Genetics. By Raymond Pearl. Pp. vii+182. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 5*s*. 6*d*. net.

DR. RAYMOND PEARL'S book inquires into the methodology of modern genetic science, and does so with clearness, concreteness, and vigour. The first chapter discusses the current modes of research on heredity, by which is meant the complex

of causes which determine the resemblance between individuals genetically related. "The critical problem of inheritance is the problem of the cause, the material basis, and the maintenance of the somatogenic specificity of germinal substance." Towards a solution of this problem contributions have been made along four lines—biometric, Mendelian, cytological, and embryological, and each of these methods is valuable and necessary. But they have at least one fundamental limitation in common. "This is that they offer no means of *directly* getting at any definite information regarding the origin, cause, or real nature of that specificity of living material which is the very foundation of the phenomenon of heredity." The most hopeful line of attack on this outstanding problem is biochemical.

A second chapter deals with the value and likewise the limitations of biometric methods, and it is full of good sense and good counsel. "To attempt to draw conclusions in regard to inheritance from studies involving the correlation method alone is futile." Third comes a useful essay on the nature of statistical knowledge, which is not, as some would have us believe, a higher kind of knowledge than that obtained in other ways. The statistical method furnishes shorthand descriptions of groups and a test of the probable trustworthiness of conclusions.

"It is, however, a descriptive method only, and has the limitations as a weapon of research which that fact implies." After a more technical chapter on certain logical and mathematical aspects of the problem of inbreeding, the author completes his interesting volume with the warning that the value of research in genetics is to be judged by its contributions to knowledge rather than by its aid to the practical breeder—useful as that aid may be.

The Universal Mind and the Great War. Outlines of a New Religion, Universalism, based on science and the facts of creative evolution. By E. Drake. Pp. vii+100. (London: C. W. Daniel, Ltd., n.d.) Price 2s. 6d. net.

THERE is much honest and suggestive thinking in this book, though the writer is sometimes both pedantic and ill-informed. Having proclaimed the bankruptcy of all dogmatic religion, all philosophy, and all ethics, he proceeds to give us the right thing. Matter and mind are the two certainties; they are entities, of which we can know only the manifestations. The universal mind is individualised in each living organism, the creative intellect directing matter from within. God is in us; we are His direct personification. From the first beginnings of life on the planet He has been moulding matter for His ends of manifestation, dropping the saurian forms, *e.g.*, when not found to work, and trying another tack. He is continually *fighting matter,* aiming at fuller control, fuller manifestation; and matter is so big and strong that only a bit at a time can be grappled with—*i.e.*, the part which thereby we see as "alive." At death the mind that was in the organism survives, but in what form—individualised or not—we cannot know. The whole argument is in the right direction, though it is crudely put; if the author had read Fechner and Samuel Butler he might have improved it. Both of these see God as Logos manifesting through matter; but Fechner from the beginning, and Butler after trying a theory almost exactly identical with Mr. Drake's and finding it unsatisfactory, accept Him as energising not only through that small portion of matter which we call "living," but through all the matter of the universe.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Gravitation and Temperature.

I SHOULD like to make a statement on the very suggestive contribution by "J. L." in NATURE, June 15, regarding my result of a temperature effect for gravitation of $+1{\cdot}2\times10^{-5}$ per 1° C. The confirmation, or otherwise, of this result will come, of course, from the laboratory, not the study. Still, a discussion at this difficult juncture might define the issue and perhaps indicate the best line for further experiment.

To take the scanty known data chronologically:

I. From Kepler's third law we deduce that gravitational mass (*g.m.*) and inertia mass (*i.m.*) vary together at the same rate, if at all, with temperature change. The mean temperature of the larger planets is probably much higher than that of the smaller ones. Thus if it were established that at these high temperatures *g.m.* rises with temperature, *i.m.* must rise proportionally. Any small departure from this principle would appear as a change in the mean motion for the observed distance, not as a periodic inequality; so it would be cumulative, and, with the great accuracy of modern astronomical methods, should be observed, unless very small. No such effect is known.

II. The pendulum experiments of Bessel establish the same principle, but since the temperature range is very small, this test is probably much less severe.

III. Poynting and Phillips found that for change in temperature of 100° in a mass of 200 grams, counterpoised on a balance, the change in *g.m.* is less than $1/10^9$ per 1° C. This very exact and direct result, taken in conjunction with I. and II., would seem to show that in the case of a gravitational couplet of a very large mass M and a small mass m the temperature of the latter can vary considerably at ordinary temperature without sensible change in *g.m.* or *i.m.*

IV. My result, quoted above, shows that when M, but not m, is raised in temperature, there is an increase in *g.m.* It will be seen that this case differs from I., II., and III., in that here the large, not the small, mass has temperature varied. My result appears to be in direct conflict with III. Can we make any justifiable physical assumptions whereby this seeming conflict may disappear?

A simple view of the effect of temperature on attraction is that the gravitational masses M, m increase with temperature, and the two increased masses, $M(1+\alpha T)$ and $m(1+\alpha t)$, would be multiplied together to obtain the resulting attraction Thus,

before rise of temperature, we have GMm/d^2. After rise we have

$$\frac{GMm}{d^2}\left[1+\alpha(T+t)\right].$$

If we, however, assume that increments in *g.m.* are multiplied separately, we should have

$$\frac{GMm}{d^2}\left[1+\alpha^2(Tt)\right]$$

Neither of these formulæ helps us to reconcile the above facts.

But now suppose that gravitational attraction between two masses consists of two parts:—

(*a*) The essential-mass term. Attraction between the masses occurs in virtue of the ether displaced by the Faraday tubes attached to their electrons. This would be like Maxwell's stress theory of gravitation: compression of ether radially from each body and tensions in directions perpendicular to the radii. This term is represented by the usual form $f_1=GMm/d^2$. It is independent of molecular vibration and exists at absolute zero.

(*b*) The temperature term. Attraction is due to vibration of the Faraday tubes, which are carried to-and-fro by the molecules in their vibratory motion. This is like Challis's wave theory of gravitation, whereby bodies in a vibrating medium attract one another if their phases are in close agreement. Dr. C. V. Burton suggested that for very high velocity of wave transmission the vibrating bodies might resonate one another and have approximately like phases. Presumably the waves in this case are longitudinal and their velocity nearly infinite. If the power that one mass has of setting another to resonate depends on the ratio, mass of vibrator/total mass, this attraction would be

$$f_2=\frac{G}{d^2}\left[M\alpha T\left(\frac{M}{M+m}\right)m+m\alpha_t\left(\frac{m}{M+m}\right)M\right].$$

Adding (*a*) and (*b*) terms,

$$f=f_1+f_2=\frac{GMm}{d^2}\left[1+\alpha\left(\frac{MT+mt}{M+m}\right)\right]. \quad . \quad . \quad . \quad \text{i.}$$

This expression was suggested, though not derived, by Poynting and Phillips. Evidently, when M preponderates greatly over m (the only case we need consider),

$$f=\frac{GMm}{d^2}\left(1+\alpha T\right),$$

so that a change in temperature of M might affect f appreciably, but no such change in m could do so.

This expression, then, would make all the facts compatible. We have supposed that the temperature effect depends on the first power, but it would be more natural to consider that the intensity of vibration varies as the square or higher power of temperature. In that case we should have for variation in the Newtonian constant, $G=G_0(1+\alpha T^n)$.

It may be significant that the coefficient of cubical expansion of lead (the material used), viz. $8{\cdot}4\times10^{-5}$, is *of the same order* as my result, $1{\cdot}2\times10^{-5}$, the increment of f being 1/7 of the increment in volume in the lead.

Above we have taken *g.m.* and *i.m.*, so far as these depend on ether displacement, to be invariable, but as the body rises in temperature from absolute zero, the vibrations may, especially at high temperature, cause such violent agitation of Faraday tubes that the effective displacement of ether is increased. If this were so, of course both *g.m.* and *i.m.* would increase, since in that case the essential mass would increase. Mathematicians might assist in deciding this point. But, at present, for temperatures up to, say, 500° C., we might suppose neither *g.m.* nor *i.m.* to change from this cause to any perceptible amount.

To make clear the action of the above formula, imagine the case of sun, earth, and moon. If the mean temperature of the earth were to rise greatly, say through sudden radio-activity in its interior of some element previously inactive, then the temperature term for the earth would increase by an amount small compared with the essential mass term of (sun + earth), but large compared with that of (earth + moon). Thus the earth's orbital motion would not change appreciably, but attraction between earth and moon would increase and the moon's orbital motion might be greatly affected.

Applying our formula i. to the comments of "J. L.," we should not anticipate change due to temperature in *g.m.* or *i.m.* in the cases of pendulum experiments or planetary orbital movements, nor should we expect "kicks" in moving masses the temperatures of which are suddenly changed. In like manner, a comet, even though considerably heated or cooled, would be expected to have regular motion. The great difficulties suggested by "J. L." would all vanish if formula i. or something akin were true.

It might be thought that my research, standing alone, is slender evidence on which to raise such important results; but I would mention that, as shown in my paper, my result is buttressed by indirect evidence.

If the formula i. be true, my contention is strengthened (see NATURE, October 7, 1915) that a laboratory value of G should not be considered valid for application to the attraction between masses (*e.g.* the heavenly bodies) the temperatures of which are far from ordinary. The whole problem is complicated by the high temperatures involved in the members of the solar system. We know that the rigidity of the earth, taken as a whole, is very great, so that the immense pressure in the core counteracts the fluidising influence of the very high temperature. Elasticity is, at a surface view, a molecular property; gravity is primarily an electron/ether property; nevertheless we are on unsure ground in reasoning that any property will be the same, say, at 5000° C. and at 0° C.

Following the guidance of the formula i., we may expect fruitful research if we vary the temperature of the large mass; but we should anticipate that no good results could be derived from experiments on temperature change of the small mass.

Poincaré pointed out (Report to the International Congress in Physics, 1900) that the mass of Jupiter, as derived from the orbits of its satellites, as derived from its perturbations of the large planets, and as derived from its perturbations of the small planets, has three different values. This would lead one to give to G a different value in each of the three cases. It will be seen to accord with equation i. above, for in the three cases the ratio $\left(\frac{m}{M+m}\right)$ is very different. It may be a useful fact in the present argument.

P. E. SHAW.

University College, Nottingham, June 24.

Payment for Scientific Research.

IN future discussions on this difficult but important question, it will be well that a distinction should be drawn between the case of a specialist who engages in research on a subject of his own choice, devoting as much or as little of his time as he cares to give to it, and that of a scientific expert who agrees to undertake work for the Government or some other body

on definitely stated subjects, and who is, as a general rule, expected to complete the duties within a more or less definite time-limit.

For investigations falling under the first category the problem of remuneration presents serious difficulties, and we may at least console ourselves with the knowledge that a step in the right direction has been taken by the Board of Education in requiring returns to be made of researches conducted by the staffs and graduates of our university colleges. In this connection it is, further, becoming recognised that teachers in these institutions should have sufficient opportunity in term time, as well as in vacation, for research.

It is with regard to the second class of investigation that the claim for remuneration is most urgent. From personal knowledge, I consider that it is impossible for an average skilled labourer in the scientific industry to earn a living wage consistent with his necessary expenses unless his whole time is available for remunerative duties. It is true that intervals occur, sometimes quite unexpectedly, during which he may be temporarily unemployed, and these can be utilised for purposes of research; on the other hand, there are certain periods of the year when the work is extremely heavy, and latitude of time is necessary even for the performance of paid work.

There are probably very few scientific labourers who would be justified in refusing an invitation to mark 500 examination papers at a fee of 1s. per paper in order to complete an investigation for the Government for which they received no fee. As soon, however, as the labourer accepts remuneration for a definite undertaking, his employer has some guarantee that he will not let future engagements interfere with the fulfilment of his contract. This at least applies to scientific specialists who are not members of trade unions.

I am very much afraid, however, that a great many people are undertaking unpaid work under conditions quite incompatible with the present depressed conditions of the scientific labour market. In some cases this is being done from a sense of patriotism. Undoubtedly their labours may have the effect of reducing the duration and the severity of the lesson which the enemy countries are teaching us in regard to our national neglect of science—a lesson which is the one good turn the Huns are doing us. But they are certainly tending to diminish the efficacy of that lesson.

G. H. BRYAN.

Negative Liquid Pressure at High Temperatures.

IN my paper with Lieut. Entwistle on the effect of temperature on the hissing of water when flowing through a constricted tube (Proc. Royal Soc., A. 91, 1915) I have determined the temperature coefficient of an effect which indicates that the tensile strength of water would be zero at a temperature between 279° C. and 363° C., with a mean from all the experiments published of 328° C. Sir Joseph Larmor's calculated result, 265° C., quoted by him in his letter in NATURE of June 29, agrees satisfactorily with the experimental value if we take into account the difficulty of getting the precise point at which hissing ceases, and that the result was obtained by extrapolation from observations taken at temperatures between 12° C. and 99° C. Lieut. Entwistle and I have experimented with other liquids—alcohol, benzene, acetone, and ether—and obtained results of a similar character. Experiments are now in abeyance, for my colleague is otherwise engaged.

My own view, formed from physical conceptions, was that the tensile strength of a liquid would become zero at its critical temperature. It is of very great interest that Sir Joseph has been able to show mathematically that the negative pressure can only subsist at absolute temperatures below 27/32 of the critical point of a substance.

The conclusions appended to our paper are:—

1. That the phenomenon of hissing of water passing a constriction is due to a true rupture of the stream at the point where the pressure is lowest.

2. That the temperatures at which the hissing just occurs, between 0° and 100° C., follow a law which may be expressed $V=C(\theta-t)$, where V is the velocity of the stream at a temperature t, θ the critical temperature of water, and C a constant.

If we adopt Sir Joseph Larmor's view the latter law will require to be expressed

$$V=C\{27/32(\theta+273)-(t+273)\},$$

or by a slightly more complex formula.

SIDNEY SKINNER.

South-Western Polytechnic Institute, Chelsea.
July 3.

THE PROPAGATION OF SOUND BY THE ATMOSPHERE.

SINCE the beginning of the war the sound of gun-firing in Flanders and France has often been heard in the south-eastern counties of England. There can be little doubt as to the origin of the sounds, for the reports of distant heavy guns have a character which is readily recognised. A correspondent of the *Daily Mail* (July 6) states that at Framfield (near Uckfield), in Sussex, it is easy to identify the particular kind of gun which is being used. The great distance to which the sound-waves are carried under favourable conditions is evident from the letters recently published in the *Daily Mail*. As firing has occurred lately over a great part of the Western front, the exact position of the source of the sound is uncertain. But if it were in the neighbourhood of Albert the waves must have travelled about 118 miles to Framfield, 150 miles to Sidcup, and 158 miles to Dorking.

Of far greater interest are the form and discontinuity of the sound-area. A remarkable example of the inaudibility of neighbouring reports in the face of a gentle wind was given in the last number of NATURE (p. 385). This is a subject on which many observations have been made since the beginning of the present century, especially in connection with the sounds of volcanic and other explosions. The source of sound is always surrounded by an area of regular or irregular shape within which the sound is everywhere heard, though the source is not always situated symmetrically with reference to the boundary of the area. On several occasions a second sound-area has been mapped, separated from the former by a "silent region" in which no sound is heard. Sometimes this second area partly surrounds the other, sometimes it consists only of isolated patches. As a rule, according to Dr. E. van Everdingen, who has made a detailed study of the subject,[1] the least distance of the second area from the source is much more

[1] "The Propagation of Sound in the Atmosphere." *Koninklijke Akad. van Wetenschappen te Amsterdam*, Proc., vol. xviii., 1915, pp. 933–960.

than 100 km., and the intensity of the sound at this least distance is not less than near the boundary of the inner sound-area.

Dr. van Everdingen refers to several dynamite and volcanic explosions which have been carefully studied from 1903 to 1911. He also adds some interesting observations made chiefly in Holland during the present war. The most important case is that of the bombardment of Antwerp on October 8, 1914. The reports were heard at many places in Holland within 100 km. from the source and again outside a circle of 158 km. radius, but at very few intermediate places. The silent region is bounded by two curves, which are roughly circular, the inner arc being traced for more than 180° and the outer for more than 90°. In some cases of heavy firing at later dates there are also indications of silent regions; in others an increased audibility has been established near the line of 160 km. In no case is there any certain indication of any asymmetrical propagation of the sound.[2]

Dr. van Everdingen examines the two explanations which have been offered of the existence of the silent region, one of which relies on variations of wind-velocity and temperature with the altitude; the other (von dem Borne's) on changes in the composition of the atmosphere at great heights. On the former explanation we might expect asymmetry, on the latter symmetry, with regard to the source of sound. He considers that both explanations are true and should be applied in combination. In favour of the second explanation, he urges the facts that in recent cases the outer margin of the silent region has always been about 160 km. from the probable source of sound and that no appreciable deviations from the circular form have been observed. The above distance is greater than the limiting distance (114 km.) assigned by von dem Borne, but Dr. van Everdingen shows that it agrees well with estimates made on the supposition that the percentage of hydrogen in the upper atmosphere is much smaller than that assumed by von dem Borne.

There can be no doubt as to the value and interest of Dr. van Everdingen's investigations. It would seem desirable, however, to continue and extend them. Though the existence of silent regions may be regarded as established, many more negative records are required to prove the symmetry of the region with reference to the source of sound. It must be remembered that the deep sounds of these explosions may at great distances be below the lower limit of audibility of some observers. Moreover, the mean radius of the outer margin of the silent region is very far from being constant. In one of the earliest cases in which the silent region was noticed—that of the minute-guns fired during the funeral procession of Queen Victoria on February 1, 1901 (*Knowledge*, vol. xxiv., 1901, pp. 124–5)—the radius was about 80 km.

C. DAVISON.

[2] It may be mentioned that, on October 28, 1914, the sound of the British naval guns that bombarded the Flemish coast was heard at a distance of 280 km., or 174 miles.

AERONAUTICS AND THE WAR.[1]

(1) MR. LANCHESTER'S latest book, unlike his previous works on aerial flight, can be read with considerable interest and without any great effort. The preface, by Lieut.-General Sir David Henderson, at once arrests attention and has caused more comment than any other equally long section of the book. The summary of the present aeronautical position is so interesting that a quotation of considerable length is here given. General Henderson writes:—

> There are no experts in military aeronautics; there are experts in the various branches: in flying, in scientific research, in the design and construction of aeroplanes and engines, in military organisation and tactics. But as yet there is little opportunity for the expert in one branch to gain definite knowledge of the others except by hard personal experience; in every direction there is progress, in every section of work opinion is fluid. . . . Of all the fields in which work for the advancement of military aeronautics has been undertaken in this country, that of scientific research has, up to the present, produced the results that will probably be most enduring. . . . In the work of stating and solving the problems of aeronautics, Mr. Lanchester was one of the pioneers; he was bold enough to publish the results of his investigations at a time when flying had only just been proved possible; and he has reason now to be well satisfied with the quality of his early work.

The author himself, in his introductory note, rubs in the last point very vigorously.

Mr. Lanchester commences by describing the functions of an aeronautical arm, stating that reconnaissance is the main duty, in which aircraft are related to the older arms of the Service. The opposing and destruction of enemy aircraft are classed as secondary functions. The problem of the relative merits of aeroplane and dirigible is treated at some length. Attention is directed to the superior speed of the aeroplane (practically double that of the dirigible). The limit of size is practically reached for the dirigible, whereas the present-day aeroplane nowise defines the limit, in Mr. Lanchester's opinion. This seems scarcely consistent with his present views, for his recent article in *Engineering* expresses the opinion that large aeroplanes will be less efficient than smaller ones. Mr. Lanchester is doubtful whether fighting is a primary function of the dirigible, and thinks that bomb-dropping is altogether a misuse. He points to the vulnerability of the airship, stating that "even to-day the finest of Germany's fleet of Zeppelins would be absolutely at the mercy of a modern aeroplane in the hands of a man prepared to make his one and last sacrifice." Before proceeding to more general considerations he disposes of the dirigible as a part of the aeronautical service, pointing out that if this proves untrue his main conclusions will not be affected.

The question of the vulnerability of the aero-

[1] (1) "Aircraft in Warfare: the Dawn of the Fourth Arm." By F. W. Lanchester. Pp. xviii + 222. (London: Constable and Co., Ltd., 1916.) Price 12*s.* 6*d.* net.
(2) "Aircraft in War and Peace." By W. A. Robson. Pp. xi + 176. (London: Macmillan and Co., Ltd., 1916.) Price 2*s.* 6*d.* net.

plane is next dealt with, the advantage of the small target area offered is pointed out, and the possibility of armouring for low-altitude flying discussed. The fact that an insufficiency of armour is worse than none is strongly insisted upon.

Early (experimental) model of B.E.2c. Calculated and demonstrated as inherently stable by the late Mr. E. T. Busk. From "Aircraft in Warfare."

Next follows a discussion of the principle of concentration, with numerous examples of the author's *n-square* law. This section does not call for much comment here.

Mr. Lanchester expresses the opinion that treaty restrictions framed for the other arms of the Service should not apply to the new arm, particularly pointing out that expanding bullets could be used with great effect in the destruction of the spars and struts of aeroplanes by gunfire. The question of the difficulty of aiming bombs is dealt with, and Mr. Lanchester thinks that the gun will eventually displace the bomb in the armament of aircraft.

The subject of naval aeronautics receives some attention, the great difference of the conditions from those of military aeronautics being specially remarked upon. The great value of aircraft for combating submarines is mentioned, and the question of the relative merits of seaplanes and aeroplanes carried by pontoon ships is discussed. It is stated that the pontoon ship offers better alighting facilities and enables faster machines to be used.

A great deal of space is devoted to the probable tactics of large fleets of aeroplanes. This subject gives Mr. Lanchester ample scope for his lively imagination, and his treatment of the subject is speculative in the extreme. It seems scarcely possible to define aeronautical tactics in such an extensive fashion at such an early stage in the development of the new arm.

Mr. Lanchester completes his book with a consideration of the present position, pointing out with no uncertain voice that the British aeroplane of to-day is better aerodynamically, more stable, more robust, and more weatherproof than the enemy's best machines, and in all ways better fitted for service conditions. It is stated that there was no good gun-carrying aeroplane in existence at the commencement of the war, and that the progress made has been astonishing. Reference is made to the work of the Royal Aircraft Factory, special praise being given to the full-scale experimental work of the late Mr. E. T. Busk. The scientific research work of the National Physical Laboratory receives consideration, and Mr. Lanchester reiterates that in scientific knowledge we are well ahead of all other nations. A board of aeronautical construction is advocated, as apart from the present advisory committee.

There is a brief appendix giving some details

of the Lewis gun, the chief armament of our present military machines.

As General Henderson remarks at the close of his preface, Mr. Lanchester's book is well worth reading, and there is much in it worthy of study and reflection.

(2) The book by Mr. Robson can in no sense of the word be called a scientific work. It is a book for the "man in the street" who wishes to know a little about aircraft and about the organisation of our present-day air services. A great part of the discussion of the importance of the new aeronautical arm follows Mr. Lanchester's argument very closely, often in almost identical terms. There are many extravagant phrases in the book, as an example of which may be given the author's statement, in treating of the courage and resource of British airmen: "Germany could not wrest from us our ascendancy in the air even if she had ten times as many aeroplanes as we have." This is obvious exaggeration. Mr. Robson foresees the time, after peace is established, when aerial travel and transport will be the order of the day, and everyone of moderate means will possess his own private aeroplane. This seems to be going too far at the present stage of development, and only future experience can justify the prediction of such a brilliant future for aeronautics. The book can in no way be compared with Mr. Lanchester's work on the same subject, but it may prove useful to those who want a non-technical and popularly written outline of the present, and possible future, position of aeronautics in warfare.

E. F. R.

SIR GASTON MASPERO, K.C.M.G. (Hon.).

THE receipt of the news of the sudden death of Sir Gaston Maspero, whilst attending a meeting of the Académie des Inscriptions et Belles-Lettres in Paris on Friday, June 30, has been received with keen regret not only by Egyptologists, of whose science he was the ablest and most competent living exponent, but also by archæologists generally throughout the world. To his personal friends his death was not wholly unexpected, for during the last two years he suffered severely from acute illnesses at intervals, and his usually bright and cheery outlook on life was clouded by the bitter grief he felt at the loss of his nearest and dearest during the war. His brave spirit, however, clung to his work, and the last parts of the *Annales du Service* and *Recueil de Travaux* prove by his contributions to them that his great mental faculties and powers of work remained in effective condition to the end.

Maspero was born in Paris on June 23, 1846, and his family appears to have been of Italian origin. Little is known of his early years, but whilst still a boy he devoted himself to the study of Egyptology as expounded in the works of Chabas and de Rougé. His first important publication was a copy of the hieratic text of an Egyptian hymn to the Nile, edited from papyri in the British Museum, and accompanied by a French translation; it appeared in Paris in 1868, when he was about twenty-two years old. He was greatly encouraged in his work by Mariette, who in 1854 had been commissioned by Saîd Pâshâ to found a museum of Egyptian antiquities at Bûlâk. In 1873 Maspero took the degree of Docteur-ès-Lettres, and soon after succeeded de Rougé as professor of the Collège de France. In 1878 Mariette proposed to the French Government to found an archæological mission, and, on the proposal being accepted, Mariette succeeded in obtaining the appointment of director for Maspero, who took up his duties in Cairo in 1880.

In the following year (January 17, 1881) Mariette died, and Maspero became director of the Bûlâk Museum. In a very short time he arranged the objects in the museum on a definite system, and the catalogue of them which he published formed a most valuable compendium of Egyptian archæology. That the book may still be read with pleasure and advantage is a great testimony to the literary skill and knowledge of its writer. Having arranged the museum, Maspero devoted himself to developing, throughout the country, the system of excavations which Mariette had begun, and to the completion of Mariette's unfinished editions of papyri, etc. The discovery of the royal mummies and of the necropolis of Panopolis, and the clearing of the royal pyramids at Sakkârah and of the Temple of Luxor are evidences of the activity of Maspero during the first period of his rule at Bûlâk. In 1886, for private reasons, Maspero resigned his directorship at Bûlâk and returned to Paris, where he devoted several of the best years of his life to the compilation of his monumental "Histoire Ancienne des Peuples de l'Orient Classique," which appeared in three portly quarto volumes in 1895–99. A smaller work, bearing almost the same title, was published by him in 1875, and the number of editions through which it has passed attests its utility and popularity.

After Maspero's departure from Cairo in 1886 the management of the Egyptian museum fell into weak hands, and the scandal that attended the removal of the collections from Bûlâk to the Gizah Palace will not soon be forgotten by all who are interested in Egyptology. Matters went from bad to worse until British public opinion in Egypt demanded a change of director, and another Frenchman was brought to Egypt to preside over the Service des Antiquités. After two years it became evident that the scandals connected with the administration of the museum were increasing in frequency and magnitude, and at length Maspero was induced to return to Egypt and to resume the directorship of antiquities. This he did in 1899.

From 1899 to 1914 Maspero worked with a constancy and vigour which were marvellous. He directed and visited the excavations carried out by the Egyptian Government; he inspected the temples, and tombs, and other ancient buildings each year, spending some months in the process;

he directed the publication of the volumes of the official "Catalogue," which were compiled by English, French, and German experts; he edited the *Recueil de Travaux,* the *Annales du Service,* the "Mémoires" of the French archæological mission in Cairo, and the *Bibliothèque Egyptologique,* and still found time to write his new books and to revise and re-edit long Egyptian texts. His management of the museum was broad-minded and liberal, and he did a great deal to popularise the collections in it by means of his "Guide," of which, alas! edition after edition has been published without an index!

Maspero's knowledge of Egyptology was colossal, and he was always ready to place it at the disposal of the expert as well as of the layman. He broke through the old rule of only allowing favoured investigators to excavate in Egypt, and often supported personally applications to dig made to the committee by comparatively unknown individuals. He was courteous and helpful to every honest inquirer, and, oddly enough, seemed to go out of his way to help most those who exploited his works and who most reviled his methods and belittled his learning. During the last two or three years of his career in Egypt his action in respect of the native dealers in antiquities was much criticised, and it provoked much angry comment both among natives and Europeans. But his friends knew that the mistakes he made were not due to incapacity or ignorance, but to failing health and overwork. He did his own work well, but in doing that of half a dozen other men he did some of it badly. No French official in Egypt was ever more liked and respected by the natives than Maspero, for they trusted him and regarded him as a friend, and they greatly appreciated his justness. In private life he was a delightful companion, and his stories of Oriental life and character were drawn from a fund of knowledge of the East which seemed to be literally inexhaustible. The charm of his conversation was great. His words were carefully chosen, though his expressions were often archaic and quaint, whilst the little mannerisms and gestures by which they were accompanied well suited the genial nature, the warm sympathy, and the kind-heartedness of the man. In both hemispheres his death will be greatly regretted. Maspero received the D.C.L. from Oxford in 1886, an honorary K.C.M.G. in 1909, and he was elected perpetual secretary of the Académie des Inscriptions et Belles-Lettres in 1914. E. A. W. B.

NOTES.

THE KING has been pleased to approve of the appointment of the Earl of Crawford to be President of the Board of Agriculture and Fisheries.

THE Harben lectures for 1916, on "Rivers as Sources of Water Supply," will be delivered by Dr. A. C. Houston at the Royal Institute of Public Health, 37 Russell Square, W.C., on July 13, 20, and 27, at 5 p.m.

PROF. ARTHUR SMITHELLS, F.R.S., professor of chemistry in the University of Leeds, has received a special appointment for scientific service on the Staff at General Headquarters (Home Forces) with the rank of Lieutenant-Colonel and graded for pay as a Deputy-Assistant Adjutant-General.

THE medical committee of the British Science Guild, under the chairmanship of Sir Ronald Ross, passed the following resolutions at a recent meeting: (1) The medical committee of the British Science Guild views with disfavour the suggestion that has been made by certain district councils to cease watering the streets as a war economy, and is convinced that such a step would be prejudicial to the public health. (2) The medical committee also views with great disfavour the pollution of the streets of London, and of most cities and big towns, by dogs, and considers that the attention of the Government and of municipalities should be called to the possibility of reducing the evil by increasing the tax on dogs and by enforcing by-laws. The committee considers that in towns the tax on one dog should be doubled and a large progressive increase imposed on each additional dog.

THE *Times* announces the death from wounds received in action of Lieut. C. G. Chapman, R.E., at the age of twenty-four. Lieut. Chapman, who had served in more than one of the theatres of war, was the son of Prof. R. W. Chapman, of Adelaide University. He was formerly in the Irrigation Branch of the Survey Department of the Australian Government, and had been in charge of surveying parties which did good work in the Northern Territory and the Daly River country. Since the outbreak of war, when he enlisted as a private, he took part in the survey of Lemnos for the Headquarters Staff, and afterwards passed through the Royal Engineers' School at Chatham.

ATTENTION is directed to the confusion that may be caused by the Summer Time Act in the Meteorological Office Circular, No. 1. In accordance with the Act, the use of Greenwich mean time is not interfered with for meteorological purposes, yet it is inevitable that, unless the standard of time used is always indicated in the record of observations, mistakes will occur, especially as the expression "local time" is often erroneously used as a synonym for the new "Summer Time." The scheme of hours of observation at meteorological stations is international in usage, and alternative schemes for winter and summer were never contemplated. The eight sets of observing hours are given in the Circular, and observers who cannot continue at the old hours are strongly recommended to select from the eight alternatives one which will be convenient both for summer and winter, and to change to that scheme once for all. A list is given of the observatories in the British Isles which have changed their hours of observation since the Act came into force.

A CONFERENCE organised by the Bread and Food Reform League on the national importance of utilising whole cereals in time of war was held in London on July 4. The Government was urged to make the use of whole cereals, especially whole wheat meal and 80 per cent. wheat flour, *i.e.* meal from which the less digestible woody fibre has been removed, much more general than it is at present. In this way it is claimed that not only would the national bread supply be considerably increased, but the public would be provided with a more substantial and nutritious food. The Government was further asked to take action to prevent the abstraction from cereal foods of the germ of wheat and of the strong gluten

without notification to the consumer. The questions involved in these resolutions have been before the public on several occasions during the last hundred years, most recently in the form of the "Standard" bread crusade, but the present conditions give them a new significance, and in any case the matter is of real scientific importance. In 1881 the late Sir J. H. Gilbert, in a letter to the Royal Society of Arts, expressed the view that while whole meal bread was undoubtedly beneficial to the sedentary worker, the bulk of the labouring population was better suited by a white bread containing a more concentrated nourishment. The apparent waste involved in the production of white flour is largely illusory, as the offals when fed to stock are merely converted into another form of concentrated food. Modern methods of milling have since introduced another factor, but until rigidly controlled feeding experiments on the human subject have been made, the question must remain controversial.

It is of high importance to the well-being of our industries that we should gather the views of men who stand at the head of great manufacturing concerns as to the type of man, his education and training, who in their opinion is best fitted to direct them. We welcome, therefore, the experience of so eminent an industrial leader as Sir Robert Hadfield, who, in a recent issue of the *Coal and Iron Trades Review*, has expressed himself on this subject. We have not always had this advantage; nothing in the past has been more discouraging to the directors of our scientific and technical institutions than the apathy, not to say the callous indifference, of all but a few far-seeing employers. This newly-awakened interest doubtless finds its origin in the successful industrial rivalry of the United States and Germany, and if we fail to grip the true reason for its success in the wise and ample provision of general scientific and specialised education we shall miss its vital significance. Yet the burden of Sir Robert Hadfield's message is that of the old adage, *Poeta nascitur, non fit*, that the successful "captain of industry" must have original force of character and gifts of natural temperament; in short, must possess inborn qualities that neither education nor training can bestow, but only develop. It thus becomes the business of the nation to set up what Huxley called "effective capacity-catching machinery," so that no potentially capable child shall wither in neglect. One of the greatest qualities of an organiser is the gift of selection, the ability to pick out the fit man for a given place, and if he has had a sound general education and an effective scientific training he will be in full sympathy with all grades of workers, and alive to the possibilities of each. The qualities of mind leading to scientific discovery are one thing, the gift of invention and application another, and they do not often reside in the same person; they even indicate a different order of mind. A Dalton or a Faraday would not necessarily have made a first-rate organiser of a modern business, but by their patient investigations and their penetrating vision they have made possible the great modern technical developments. The true place for the adjustment of theoretical knowledge to industrial aims and conditions is in the workshop, and if manufacturers were wise and far-seeing they would give ample opportunity to the well-educated young man to acquire this essential experience, and would find abundant reward therein.

The paper published in No. 3317 of the Journal of the Royal Society of Arts for June 16, by the Right Hon. Sir W. MacGregor, entitled "Some Native Potentates and Colleagues," supplies an admirable example of the methods by which one of our most distinguished colonial officials succeeded in gaining the confidence and affection of the native races under his control. He begins with an account of Thakambau, "the greatest and best-known man of the Fijian race," of whom it may be said that no ruler "ever saw his country transformed by such enormous changes as this Fijian chief saw and assisted in." Sedu, the Papuan, "one of the finest characters I have ever known," met an untimely fate in an ambuscade, and the Garter King-of-Arms has allowed Sir W. MacGregor to quarter a figure of this hero as the dexter supporter of his coat-of-arms. The writer's wide experience enables him to record worthies of other races, such as John Allan, an Australian Aboriginal, and the Alake of Abeokuta in West Africa. In the discussion which followed the reading of the paper the Hon. J. G. Jenkins acknowledged in graceful terms the great services of the writer in the administration of British New Guinea in the early days of the colony.

Most of the June number of the *Zoologist*, (4), vol. xx., No. 900, is occupied by Capt. Malcolm Burr's highly interesting account of his travels in the Caucasus and the Asiatic territory beyond. His military duties have taken him through a remarkable country, and he is able to record many observations on plants and animals, notably birds and orthoptera. The centre of attraction, from the naturalist's point of view, is Geok Tapa, where Capt. Burr was the guest of that famous collector, Alexander Shelkovinov.

Some facts bearing on the "struggle for existence," as understood by Darwin, are contributed in a short note, "Sur l'équilibre naturel entre les diverses espèces animales," by A. Pictet in the *C. R. des Séances de la Soc. de Physique et d'Hist. nat. de Genève* (xxxii., 1915, pp. 10–13). The author reckoned that if a pair of white butterflies (*Pieris brassicae*) produce 500 eggs, 99·6 of the larvæ must be destroyed if the numbers of the species remain constant. He then collected all the caterpillars—148 in number—from a certain bush, and found that of these 137 had been parasitised by the small ichneumonoid Microgaster, that 9 died of disease, and that only 2 completed their transformations. From the age of these collected larvæ he believed that twice as many had already perished, and thus arrives at a survival ratio (0·04 per cent.) agreeing with his estimate. The agreement thus reached after several assumptions is perhaps too close to be altogether convincing.

The January number of the *South African Journal of Science* (vol. xii., No. 6) contains an article on the Sarcosporidia by G. van de Wall de Kock, in which the effect of these obscure protozoan parasites on their mammalian hosts and their probable action in causing various diseases are discussed. Recent work on the life-history of Sarcosporidia is usefully summarised.

In the Proc. Roy. Soc. Victoria (xxviii., 1916, part 2) Miss G. Buchanan gives the results of a comparative examination of the blood of certain Australian animals, with coloured figures of the various forms of corpuscles. She finds a general decrease in size and increase in number of red cells in ascending through the vertebrate classes, while the lymphocytes decrease in number and increase in size. The reptilian relationship of the Monotremes is suggested by a

similarity in the mononuclear corpuscles. Platelets were recognised in mammalia only.

VALUABLE reports on sponges (calcareous and non-calcareous) from the Indian Ocean have lately been published by Prof. A. Dendy in the "Report to the Government of Baroda on the Marine Zoology of Okhamandal, in Kattiawar" (part ii., pp. 79–146, 10 plates). The specimens described were collected by Mr. J. Hornell in 1905–6. Many of the calcareous species are identical with those from the African coast, while a large proportion of the Tetraxonida and Ceratosa were already known from the seas around Ceylon. The plates show the general aspect and the spicules of the new species; unfortunately, the material was largely unsuitable for histological study, and it is to be hoped that collectors will take to heart Prof. Dendy's exhortation to avoid formalin as a preservative for sponges.

IN the recently issued part, No. 4, of vol. v. of the Transactions of the Royal Society of South Africa Mr. F. Eyles contributes a long list of plants collected in southern Rhodesia. His record, which occupies 251 pages and is furnished with a full index, includes representatives of 160 families, 869 genera, and 2397 species. The plants collected are mainly flowering plants and ferns, and details of localities, collectors' names, and numbers are given for each species. The record will prove of value to students of African botany, and especially to those of the Rhodesian flora; it should also serve to encourage others to collect and study the plants of the country.

A STUDY of the geography of the Fox Valley is the first of a series of regional surveys on the State of Wisconsin, U.S.A. Three years ago the Wisconsin Geological and Natural History Survey published an introductory survey devoted to the State as a whole. The present volume (Bulletin xlii., Educational Series, No. 5) is by Prof. R. H. Whitbeck, and, like the preliminary one, is published by the State. The object of the work is educational in the main, and the study of geography in the schools of the district will certainly be helped by the use of this intensive survey of a small region. Physical considerations occupy but a small part of the volume, which is mainly concerned with cities and industries. The requirements of school children appear to have been kept well in view throughout, and yet the book avoids being either trivial or didactic.

THE question of the nature and origin of the minute plates that impart the "aventurine" effect to felspars appears to have been finally solved by Olaf Andersen ("An Aventurine Feldspar," *Amer. Journ. Sci.*, vol. xl., 1915, p. 351). The author, after goniometric and optical investigation, adopts Scheerer's view, put forward in 1845, that the substance present is hæmatite. His research covers American albites, oligoclase from Kragerö and Tvedestrand (sunstone), labradorite from Labrador, and several microclines. The plates are found always to be oriented after simple crystal forms, although these forms may not be present in the felspar crystal; but the edges of the plates do not yield simple crystallographic relations. These edges, however, are referred to a mineral with hexagonal or trigonal symmetry. The author believes that Fe_2O_3 was originally present in solid solution in the felspar, either as hæmatite or as a constituent of a ferric compound; a disturbance of equilibrium, perhaps a temperature-change, has caused it to separate out as individual crystals of hæmatite along structural planes of the felspar. The bluish tints of the schillerised moonstones, murchisonites, and labradorites are said to be due, like the blue of the sky, to the "scattering of light by particles smaller than the wave-length of light, and cannot be explained as ordinary interference colours of thin films."

IN the Journal of the Washington Academy of Sciences for June 4 Mr. Paul D. Foote, of the U.S. Bureau of Standards, shows how the melting points of metals, *e.g.* tungsten, can be determined from the luminosity of the molten metal. The radiation at absolute temperature θ of a black body between wave-lengths λ and $\lambda + a\lambda$ being taken as $c_1\lambda^{-5}e^{-c_2/\lambda\theta} . d\lambda$, where c_1 and c_2 are constants, that of a metal over the visible part of the spectrum the author represents by $c_1\lambda^{-5}e^{-c_2/\lambda\theta} . Ae^{q/\theta} . e^{c_2 p/\lambda} . d\lambda$, where p and q are constants. If $V(\lambda)$ is the visibility of radiation λ, the luminosity of the surface of the metal is

$$Ae^{q/\theta} . c_1\int_0^\infty \lambda^{-5}e^{-c_2/\lambda(1/\theta - p)} . V(\lambda)d\lambda.$$

On writing $1/\theta' = 1/\theta - p$, this becomes

$$Ae^{q/\theta} . c_1\int_0^\infty \lambda^{-5}e^{c_2/\lambda\theta'}V(\lambda)d\lambda,$$

which, with the proper value of $V(\lambda)$, has been shown graphically to reduce to $Ae^{q/\theta} . P\{(\theta' + B)/(\theta' + C)\}^D$, where P, B, C, D are constants. In the case of tungsten the author shows that the values of the constants are $A = 0{\cdot}303$, $p = 1{\cdot}04 \times 10^{-5}$, $q = 322$, $c_2 = 14450$, $B = -106$, $C = 265$, $D = 72$, $P = 1{\cdot}91 \times 10^{-7}$. From Langmuir's observation that at the melting point tungsten has a luminosity of 6994 candles per square centimetre, it is shown that the preceding constants give 3712° as the absolute temperature of the molten surface. This method of determining high temperatures seems likely to prove of great value.

THE *Mathematical Gazette* for May contains a paper by Prof. H. S. Carslaw entitled "A Progressive Income Tax," dealing with the complicated system of taxation adopted in Australia. Although the British Chancellor of the Exchequer took his B.A. degree in the Cambridge Mathematical Tripos in 1886, he seems to have so far forgotten all his mathematics that he has imposed taxes at the rates of more than 2500, 5000, or 8000 per cent. on persons whose incomes exceed 1000*l.*, 1500*l.*, or 2000*l.* by a single pound. It would be more correct to say that the rate becomes infinity in the pound at these points of the scale, and the case may easily arise in which a professional man may have to throw up his duties at short notice in order to avoid losing money by earning more. But in Australia they appear to have gone to the opposite extreme, and determined the rate of tax by complicated mathematical formulæ defined by curves of the second and third degrees. Indeed, Prof. Carslaw has to use the integral calculus in the examples that he works. Why cannot Chancellors of the Exchequer bring a little more common sense, as well as *elementary* mathematical knowledge, to bear on income-tax problems? The discontinuities in the *gradient* of the income-tax curve, which the Australians have taken so much trouble to eliminate, are of no very great moment, while the present English discontinuities in the *total amount* of the tax are open to serious objection. With 100*l.* exempt, and rates of 2*s.* 6*d.* on the next 400*l.*, 4*s.* on the next 500*l.*, and 5*s.*, 6*s.*, and 7*s.* on subsequent additions to income of 500*l.*, the average rate on 2500*l.* would be very nearly 5*s.* in the pound, but the man with 2000*l.* who earned an extra 1*l.* would still gain 13*s.* instead of losing more than 50*l.* or 80*l.*

THE statement that, since the war began, Germany has succeeded in obtaining her full supply of nitrates

by fixation from atmospheric nitrogen lends additional interest to the account of a Swedish company for the same purpose contained in *Dagens Nyheter* (June 8). Eyde's method of obtaining nitrogen from the air by means of an electric arc is relatively dear, and its profits depend on the local price of electrical energy. It has, moreover, been calculated that if all the waterfalls of Europe were to supply energy for this industry alone, this would not result in a greater production than would balance the present yearly increase in the world's need of fertilisers. The Swedish company employs a method invented by Th. Thorssell (formerly technical head of the fertiliser and sulphuric acid factories in Malmö), which method depends on purely chemical processes, and demands only the special treatment of easily accessible raw material; but no details of the process are given in the article. The chief products of the new factory are ammonia, ammonium nitrate and cyanide compounds, saltpetre, and sulphuric acid. The process is said to be of such a character that factories can be installed in most places without requiring any large supply of energy. Experimental work was begun in the autumn of 1911, and during the summer of 1912 the results were approved by the outside experts—Prof. H. G. Söderbaum and Dr. Gustaf Ekman. The company was then set going definitely, and, in spite of difficulties inseparable from an entirely new manufacture, as well as losses by fire, it is now preparing to deliver its products in large quantities, and has for this purpose decided to increase its capital from 3·7 million to 8 million kronor.

PROF. OTTO PETTERSSON, of Holma, Lysekil, Sweden, has devised an apparatus for saving life at sea which presents some features of novelty and interest. It consists of three parts: (1) An ordinary horsehair mattress of the thickness, width, and length which are usual for a ship's berth. This mattress is to form the bottom of what will be a kind of collapsible boat when used for life-saving. (2) Attached to the sides of the mattress, and capable of being folded underneath it when used for sleeping purposes, are two cushions which, when the whole is employed for life-saving, form the sides of the craft and on which its buoyancy depends. In the original model these cushions were filled with the hair of the reindeer—a material much used for such purposes in Scandinavia—but, of course, kopok would be equally serviceable. (3) The stem and stern of the little craft are formed of double layers of impermeable, closely woven waterproofed cloth strengthened by cords sewn in and uniting at the ends of the mattress in a metal ring, to which the rope of a sea-anchor may be fixed. Each seam is strengthened by a layer of india-rubber to keep the water from entering the inner stuffing of the mattress. Between the mattress and the side cushions are two pieces of cloth with holes for putting the arms through. The whole forms a sort of cloak in which one wraps oneself, as in an ulster coat, securing it round the waist. The sea-anchor is taken in one hand and one flings oneself backward into the sea. The anchor is let go and the craft emptied of water by a syringe which is placed at the side and is easily worked by the passenger. Once emptied it will not easily fill again, the sea-anchor keeping the prow against the wind and the waves. The little boat is unsinkable, even when filled with water, and is sufficiently buoyant to carry more than one person. If two or three boats are tied together by the anchor line one sea-anchor will keep them steady. The sea-anchor is an essential part of the apparatus. It consists of a canvas bag sewn on to a metal ring, and is provided with a stout manila rope about 20 m. long. The apparatus is made by K. M. Lundberg, of Stockholm, and has been proved to be very serviceable.

AN article on "Fruits for Health, Strength, and Longevity," which appears in the *Fortnightly Review* for July, though an advocacy of fruitarianism, fails to offer any convincing physiological argument in support of the end in view. Like most productions of its kind it consists of manifest inaccuracies mixed with a modicum of truth. For example, "when a man reaches the age of fifty, especially should he be careful about his diet," is only too true; but that "the juices of oranges and lemons act like magic upon the waste chalky accumulations which bring about the stiffening of the arteries"—in other words, cure arteriosclerosis—is a statement unsupported by experimental evidence in the field of modern therapeutics. Nor is there sufficient evidence to show that eating fish and the flesh of the pig is in any way associated with cancer, scrofula, and tumours. Fruit jellies are said to "possess no nitrogen"! and "*condensed starch* seriously taxes the digestive organs." What is condensed starch? "The action of glucose, like that of cornflour, induces sluggish action of the system and tends to disorganisation, driving consumers to purgatives." Yet many fruits are rich in glucose or sugars readily converted into glucose. Moreover glucose has a mild aperient action on most people. "Utilised over a course of years ripe fresh fruits and their juices will effectually prevent aneurismal dilatations and arterial rupture, which of late years have increased to an alarming extent." It would be interesting to know what medical evidence there is for either of these conclusions.

THE June issue of the Chemical Society's Journal contains a report of a lecture by Dr. F. Gowland Hopkins delivered before the society on May 18 on "Newer Standpoints in the Study of Nutrition." This is the third of a series of lectures delivered by invitation of the council during the past session, the two earlier lectures having been given by Dr. E. J. Russell and by Prof. W. H. Bragg. To the chemist, Dr. Hopkins's lecture is particularly attractive by reason of the large measure of success which the author has achieved in his endeavour to interpret biochemical phenomena in terms of the known reactions and products of organic chemistry. Amino-acids, such as tryptophane, arginine and histidine, glutamic and aspartic acids, derived from the hydrolysis of natural proteins, are shown to be the essential units in the nutrition of animals. If these are provided, together with filtered butter-fat or lard, potato-starch, cane sugar, the requisite inorganic salts, and the mysterious vitamine or food-hormone factor (supplied in the form of a nitrogen-free alcoholic extract of fresh milk), life can be preserved and growth maintained without protein or any nitrogenous compounds of unknown constitution. Interesting experiments have been made which show that the withholding of the aromatic compound tryptophane, or of both arginine and histidine, prevents growth and causes a rapid loss of weight; but glutamic and aspartic acids, which constitute 28 per cent. of the protein molecule (as contrasted with $1\frac{1}{2}$ per cent. of tryptophane), can both be removed without causing loss of body-weight or even any marked retardation of growth; and the removal of histidine and arginine separately does not arrest growth, indicating that these two amino-acids can replace one another in nutrition, and may even prove to be chemically interconvertible.

OUR ASTRONOMICAL COLUMN.

A PARTIAL ECLIPSE OF THE MOON.—The moon will be in partial eclipse during the early morning hours of Saturday, July 15. The first contact with the shadow occurs at 3h. 19·3m. a.m., the angle from the north point being 40° to E. At Greenwich the moon sets at 3h. 59m. a.m. (one hour later in legal time), nearly 47 minutes before the middle phase.

A BRIGHT METEOR.—A notable meteor was observed at the Hill Observatory, Sidmouth, early on July 8. First seen at 1h. 5m. a.m. G.M.T. a little E. of N. about 15° above the sky-line, rising in the sky, it then passed not quite overhead and reached 30°–40° beyond the zenith. Unfortunately, although the sky was clear and the meteor considerably exceeded Jupiter in brightness, it left no visible trail. The meteor gave the illusory impression of coming quite near to the observer and not of describing a meridian, an effect no doubt largely due to its increasing brilliancy.

COMET 1916*b* (WOLF).—An investigation of the orbit of this comet has been carried out by Messrs. R. T. Crawford and Dinsmore Alter, of the Berkeley Astronomical Department (Lick Obs. Bull., No. 282). From this it appears that Prof. Barnard succeeded in identifying the comet on a photograph taken on April 24. The time of the observation indicates that it must be the same photograph on which a confusion of the minor planet 446 Æternitas with the new comet had been pointed out by the editors of the *Astronomisch Nachrichten* (No. 4845). The earliest position available to the American calculators was that derived from Prof. Barnard's plate. With this and other observations made at Yerkes, May 10 and May 23, the following differentially corrected parabolic orbit has been calculated:—

$$T = 1917 \text{ June } 16{\cdot}48c6 \text{ G.M.T.}$$
$$\omega = 120^\circ\ 37'\ 07{\cdot}9'' \qquad \Omega = 183^\circ\ 16'\ 58{\cdot}8''$$
$$i = 25^\circ\ 40'\ 06{\cdot}4'' \qquad \log q = 0{\cdot}226855$$

These elements and the resulting ephemeris only differ slightly from the calculations by Prof. A. Berberich (NATURE, June 1). Numerous American observations, mostly made at Yerkes, are represented closely. The orbit resembles that of Wolf's periodic comet 1884, III., and consequently an elliptic orbit with a period of seven years was calculated; the differences, however, disproved identity. The faint luminosity and low altitude of the comet now probably put it out of reach until it becomes a morning star.

AREQUIPA PYRHELIOMETRY.—In consequence of the recommendations of the Committee of the International Union of Solar Research, measures of solar radiation have been made at Arequipa since 1912. Some of the results so far obtained have been published by C. G. Abbot (Smithsonian Miscellaneous Collection, vol. lxv., No. 9). Special attention has been given to the question of solar variability and atmospheric transmission. At Arequipa the chief factor in the latter connection is the amount of water vapour, and consequently the silver-disc pyrheliometer measures of radiation have been supplemented by a nearly simultaneous series of measures of atmospheric humidity. The monthly mean values show a close connection between the solar radiation and vapour pressure. This was represented by empirical formulæ which gave values of the solar constant in good agreement with the more rigorous values obtained at Mount Wilson and generally confirming the variability of the solar radiation.

The dust of the Katmai eruption (June, 1912) did not affect the Arequipa measures.

CANADIAN ECONOMIC GEOLOGY.[1]

THE White River District of Yukon extends east from the Alaskan-Canadian boundary, and its geology continues that of country well known by the work of the American geologists. Some Carboniferous rocks, resting on an Archean foundation, are followed by thick Mesozoic sediments which contain a few Cretaceous fossils. The Cainozoic is represented by land and fresh-water beds containing lignites. As in Alaska, there are two volcanic series, one of which was erupted during the world-wide disturbances between the Jurassic and Cretaceous, and the other is Upper Cainozoic and continued until very recent though pre-Glacial times. In the early Pliocene the country was uplifted and greatly fractured, the evidence of which is most distinct on the coast. The chief ores of the White River District are of gold and copper. The discovery of the placer deposits at Chisana in 1913 occasioned the greatest "stampede" or mining rush since that to Klondyke in 1897–98. The copper ores have long been worked by the Indians, and in 1891 the exaggerated reports of their quantity led to the first prospecting of the country. Mr. Cairnes's memoir is illustrated by some excellent maps and photographs.

At the opposite corner of Canada, on the southern shore of the Northumberland Strait, is an area strikingly unlike the White River District. It was one of the first Canadian districts geologically investigated; it was settled during the latter part of the eighteenth century, and the names Arisaig, Knoydart, Moydart, Lismore, etc., show that the pioneers were the expatriated exiles from the western Highlands. The district is composed of Palæozoic rocks ranging from the Ordovician to the Upper Carboniferous, with some Ordovician rhyolite lavas and Upper Palæozoic diabase dykes. The surveys of recent years have supplemented and in some respects corrected the earlier results of Dawson and Honeyman. Thus there is a full Silurian sequence, as the Moydart beds represent the Wenlock series, which had been considered absent. The Devonian is represented by the Knoydart series, which is correlated with the British Lower Old Red Sandstone. The absence of the Middle and Upper Old Red Sandstone is attributed to great faulting, that corresponds to that which caused the absence of the Middle series from south-western Scotland. The Carboniferous is represented, as in Britain, by a lower marine series and an upper continental series.

The most interesting economic deposits in this district are the Silurian oolitic ironstones, which the author infers from their special fauna were laid down under unusual conditions, during which the sea contained much ferruginous material. This view is not adequately explained, and there is no proof that the ores were not due to a partial replacement of an oolitic limestone. The report is accompanied by two clear geological maps.

The oil discoveries in the United States in the early 'sixties stimulated research for oil in eastern Canada. Oil was found, though in comparatively small quantities, and some of the districts continued to yield ever since. This oil belt extends from Lake Huron to the Gaspe peninsula, south of the mouth of the St. Lawrence. The most important fields are in the south-western peninsula of Ontario, south of a line from the southern end of Lake Huron to the western end of Lake Ontario. The oils come from various hori-

[1] D. D. Cairnes: Upper White River District, Yukon. Canada, Department of Mines, Geol. Surv. Mem. 50, Geol. Ser., 51, 1915, iv. Pp. 191+xvii plates+3 maps.

M. Y. Williams: Arisaig-Antigonish District, Nova Scotia. *Ibid.*, Mem. 60. Geol. Ser., 47. 1914. vi. Pp. 173+2 maps.

W. Malcolm: The Oil and Gas Fields of Ontario and Quebec. *Ibid.*, Mem. 81, Geol. Ser., 67, 1915, ii. Pp. 248.

zons. There are traces in the Trenton (Ordovician); small quantities are obtained from four distinct Silurian series. The largest quantity of oil comes from the Onondaga beds, which are Devonian. The author mentions both the organic and inorganic theories of the origin of petroleum; he expresses no definite preference, but appears to be inclined to the latter, and some of the facts stated in the memoir indicate why some Canadian geologists are firmly attached to that view. The most interesting evidence is based on the uniform composition of the associated natural gas, which is advanced as incompatible with its local origin; but the balance of the evidence stated seems difficult to reconcile with the inorganic hypothesis.

Each of the three memoirs is a useful contribution to Canadian geology. J. W. G.

RADIO-ACTIVITY AND PLANT GROWTH.

FOR some time past Mr. Martin Sutton has been making experiments on the effects of radio-active ores and residues on plant growth. A preliminary account of the experiments was given in NATURE for October 7, 1915, and the detailed report now to hand, issued as Bulletin No. 7, from Messrs. Sutton, of Reading, confirms the conclusions then drawn. The experiments were soundly conceived and well carried out; the results showed that radium compounds have no sufficient effect on plant growth to justify any hopes of practical application in horticulture or agriculture.

The experiments were made with tomatoes, potatoes, radishes, lettuces, vegetable marrows, carrots, onions, and spinach beets; some of the plants were grown in pots, and others in the open ground. Pure radium bromide was used in some experiments, and radium ores in others. In order to eliminate the effect of substances other than radium present in the ores, a mixture of these was made and applied to some of the plants. In certain cases small increases in growth over the unmanured plants were obtained, but nothing approaching the increases given by artificial fertilisers or farmyard manure.

A number of rather extravagant claims are thus disposed of, including one to the effect that radium treatment caused plants to take on certain flavours that they do not naturally possess. Thus a previous investigator had claimed that vegetable marrows grown in presence of radium compounds assume the flavour of pineapples; Mr. Sutton's marrows were cooked and tasted by a distinguished exponent of horticultural science, whose tastes in these matters are recognised as being beyond reproach, and were found to be indistinguishable from the others. Mr. Sutton has rendered good service by disposing of this and other of the hares started in the field of horticulture that were distracting attention from the larger problems with which the horticulturist has to deal.

THE ORGANISATION OF INDUSTRIAL SCIENTIFIC RESEARCH.[1]

I.

IF one attempted to formulate the common belief concerning the origin and development of modern technical industries, it would probably be found that stress would be laid upon financial ability or manufacturing skill on the part of the founders; but if, instead, we were to make a historical survey of the subject, I think that we should find that the starting and development of most manufacturing businesses depended upon discoveries and inventions being made by some individual or group of individuals who developed their original discoveries into an industrial process. Indeed, if the localities in which various industries have developed be marked on the map, they will often be found to have far more relation to the accidental location, by birth or otherwise, of individuals than to any natural advantages possessed by the situation for the particular industry concerned. The metallurgical industries, of course, are situated chiefly near the sources of the ores or of coal, but why should the chief seat of the spinning industry be in Lancashire or of modern optical industry in Jena, except that in those places lived the men who developed the processes which are used in the industry? And, moreover, industries are frequently transferred from one locality to another, and even from one country to another, by the development of new processes, generally by new individuals or groups of workers.

The history of many industries is that they were originated and developed in the first place by some man of genius who was fully acquainted with the practice of the industry and with such theory as was then known; that his successors failed to keep up with the progress and with the theory of the cognate sciences; and that sooner or later some other genius working on the subject has rapidly advanced the available knowledge, and has again given a new spurt to the development of that industry in another locality.

Thus, in the early days of the technical industries the development of new processes and methods was often dependent upon some one man, who frequently became the owner of the firm which exploited his discoveries. But with the increasing complexity of industry and the parallel increase in the amount of technical and scientific information, necessitating increasing specialisation, the work of investigation and development which used to be performed by an individual has been delegated to special departments of the organisation, one example of which is the modern industrial research laboratory.

The triumphs which have already been won by these research laboratories are common knowledge. The incandescent lamp industry, for instance, originated in the United States with the carbon lamp, but was nearly lost to the United States when the tungsten filament was developed, only to be rescued from that danger by the research laboratory of the General Electric Company, who fought for the prize in sight and developed, first, the drawn-wire filament, and then the nitrogen lamp; and we may be sure that if the theoretical and practical work of the research laboratory of the General Electric Company were not kept up the American manufacturers could by no means rest secure in their industry, as, undoubtedly, later developments in electric lighting will come, and the industry might be transferred, in part, if not completely, to the originators of any improvement. Manufacturing concerns, and especially the powerful, well-organised companies who are the leaders of industry in this country, can, of course, retain their leadership for a number of years against more progressive but smaller and less completely organised competitors, but eventually they can ensure their position only by having in their employ men who are competent to keep in touch with, and themselves to advance, the subject, and the maintenance of a laboratory staffed by such men is a final insurance against eventual loss of the control of its industry by any concern.

There was a time when the chief makers of photographic lenses were the British firms, the owners of which had been largely instrumental in developing the early theory of lens optics, but that position was lost entirely as a result of the scientific work of the German opticians, led by Ernst Abbe; in a smaller divi-

[1] An address delivered at Columbia University by Dr. C. E. Kenneth Mees, director of the Research Laboratory, Eastman Kodak Co., Rochester, N.Y.

sion of optical work, however, the staff of Adam Hilger, Ltd., has been able by its superior knowledge and intensive study of the manufacture of modern spectroscopes to transfer a large portion of the manufacture of such instruments from Germany to England again.

In a recent book review in NATURE (December 2, 1915, p. 366) it is pointed out that the rare earth industry has been chiefly concentrated in Germany. The manufacture of gas mantles, discovered by an Austrian, developed an entirely new chemical industry, which has been carried on almost completely under German auspices. It seems to be suggested at the present time by some of the leaders of British industry that such specialised chemical operations as the manufacture of compounds of the rare earths can be transferred to Great Britain by the application of superior financial methods, or better business foresight, or even merely more intense application. I do not believe that anyone who is acquainted with the business men of several countries will believe that the British manufacturer is lacking either in financial capacity, or in business foresight, or in application, but none of these things by itself will develop a chemical industry. The only thing that will attract and retain the business is the manufacture and development of new and improved products, and this can be done only by the use of more and better research chemists and physicists than the competitor is willing to employ. In fact, at the present time it seems to be clear that the future of any industry depends upon its being able to command a sufficient supply of knowledge directed towards the improvement of the product and the development of the methods of that industry, and that any failure in this respect may involve eventual failure. While this view of the importance of research work to the industries is now obtaining universal acceptance, I feel that many who assent without hesitation to the value of a research laboratory still take far too low a view of the work which it should perform.

Industrial laboratories may be classified in three general divisions:—

(1) Works laboratories exerting analytical control over materials or processes.

(2) Industrial laboratories working on improvements in product and in processes, tending to lessen cost of production and to introduce new products on the market.

(3) Laboratories working on pure theory and on the fundamental sciences associated with the industry.

The first class of laboratories are so obviously necessary that practically all works are so equipped, and frequently each department of a factory maintains its own control laboratory. The second class of laboratories are frequently termed "research" laboratories, and this type has been very largely instrumental in forwarding the introduction of scientific control into industry.

Unfortunately, however, the immediate success of the application of scientific methods to industrial processes has often led the executives of commercial enterprises into the belief that such work along directly practical lines is capable of indefinite extension, and in this belief a number of laboratories have been started, some of which, at any rate, have been sources of disappointment in consequence of a failure to grasp the fact that if the whole future of an industry is dependent on the work of the research laboratory, then what is required is not merely an improvement in processes or a cheapening in the cost of manufacture, but fundamental development in the whole subject in which the manufacturing firm is interested, and for this purpose it is clear that something very different from the usual works laboratory will be required, and that in order to attain progress the work of the research laboratory must be directed primarily towards the fundamental theory of the subject. This is a point which seems to be continually overlooked in discussions of industrial scientific research, where such stress is generally laid upon the immediate returns which can be obtained from works laboratories, and upon the advantage of scientific control of the operations; but in every case where the effect of research work has been very marked, that work has been directed, not towards the superficial processes of industry, but towards the fundamental and underlying theory of the subject. From Abbe's work on lenses, and Abbe and Schott's work on glasses, to the work of the research laboratory of the General Electric Company on the residual gases in lamp vacua, which resulted in the production of the nitrogen-tungsten lamp and the Coolidge X-ray tube, this will be seen to be true, and we must consequently agree that for industries to retain their position and make progress they must earnestly devote time and money to the investigation of the fundamental theory underlying the subject in which they are interested.

Research work of this fundamental kind involves a laboratory very different from the usual works laboratory, and also investigators of a different type from those employed in a purely industrial laboratory. It means a large, elaborately equipped, and heavily staffed laboratory, engaged largely on work which for many years will be unremunerative, and which, for a considerable time after its foundation, will obtain no results at all which can be applied by the manufacturer.

The value of a research laboratory is essentially cumulative; in the beginning it may be of service as bringing a new point of view to bear on many problems; later, accumulated information will be more and more available; but most men acquainted with industrial research work consider that five years is the earliest date at which any considerable results can be expected from a newly-established research laboratory, and that the development of really new material in considerable quantities so that it will have an effect upon the industry as a whole cannot be looked for in less than ten years' consecutive work. This does not mean that a laboratory is useless during the initial period, since it will be of considerable service in many other directions than in that of its main work on the fundamental problems, but when this main line of research begins to bear fruit it will absorb the energies both of the laboratory and of the factory.

It is often suggested that the problem of the organisation of scientific industrial research is really the problem of obtaining satisfactory co-operation between the manufacturers and the universities, possibly with small research laboratories in the factories themselves acting as intermediaries. Various schemes have been suggested for enabling the universities to carry out research work of value to the manufacturers, but if it is believed that the work chiefly required for the development and maintenance of industry deals with the fundamental theory of the subject, it will be seen that this cannot possibly be carried on to any large extent in collaboration with a university; it requires a continuity of application by the same investigators over long periods, with special apparatus, and with the development of special methods which cannot be expected from any university. This necessity for continuous work along the same line is, indeed, the greatest difficulty in making use of the universities for industrial research. The conditions of a university laboratory necessarily make it almost impossible to obtain the continuous application to one problem required for success in industrial research, and, indeed,

in the interests of teaching, which is the primary business of a university, such devotion to one problem is undesirable, as tending to one-sidedness.

There are also difficulties in obtaining the co-operation of manufacturers with universities and in the application of university work to industry, which I see no hope whatever of overcoming; the universities do not understand the requirements of the manufacturer, and the manufacturer distrusts, because he does not understand, the language of the professor. Moreover, it is quite essential that any investigator who has worked out a new process or material should be able to apply his work on a semi-manufacturing scale, so that it can be transferred to the factory by skilled men who have already met the general difficulties which would be encountered in factory application. This development on a semi-manufacturing scale is, indeed, one of the most difficult parts of a research resulting in a new product, and the importance of it is shown by the fact that all the large industrial research laboratories, however concerned they may be with the theory of the subject, have, as parts of the laboratory, and under the direction of the research staff, experimental manufacturing plants which duplicate many of the processes employed in the factory itself.

All these arguments tend to show that an industrial research laboratory must necessarily be of considerable size, but this requirement is much accentuated by another consideration altogether.

Except in a few branches of pure science small research laboratories are relatively inefficient, in the technical sense of the term—that is, they require more time and cost more money for the solution of a given problem.

When considering this subject it is necessary first to dismiss completely from the mind the idea that any appreciable number of research laboratories can be staffed by geniuses. If a genius can be obtained for a given industrial research, that is, of course, an overwhelming advantage which may outweigh any disadvantages, but we have no right to assume that we can obtain geniuses; all we have a right to assume is that we can obtain, at a fair rate of recompense, well-trained, average men having a taste for research and a certain ability for investigation. The problem, then, is, how can we obtain the greatest yield from a given number of men in a given time? Investigation of the subject shows that the yield per man increases very greatly as the number of men who can co-operate together is increased. The problems of industrial research are not often of the type which can be best tackled by one or two individual thinkers, and they rarely involve directly abstract points of theory, but they continually involve difficult technical and mechanical operations, and most of the delays in research work arise because the workers engaged on the subject do not know how to do some specific operation. In my own experience, I have seen a good man stick for six months at an investigation because he did not know and could not find out how to measure a conductivity with a precision higher than one part in a thousand, a point which was finally found to be perfectly well known to several scientific workers in the country. Again, it took another good man three months to learn how to cut a special form of section, but, having learned the trick, he can now cut sections for all the workers in the laboratory with no delay whatever.

In this connection the advantage of permanent set-ups of apparatus may be pointed out. Among a large number of chemists some one will continually be wanting to photograph an ultra-violet absorption spectrum or to take a photomicrograph, and if the apparatus for these purposes is erected and in charge of a competent man who understands its use, the work can be done without any delay at all, the photography of the absorption spectrum of an organic liquid by a man who is used to the work taking only an hour; but if this point is vital to the research, and the chemist is quite unacquainted with the technique of the subject and has no apparatus available, it may easily take him six months to find out what has been done on absorption spectra, to buy and erect the apparatus and become skilled in its working.

From these causes, then, the efficiency of a laboratory increases very greatly with its size, provided that there are good arrangements for co-operation between the different workers of the laboratory, so that they are kept informed of each other's problems.

When considering the efficiency of research work it must be remembered that the efficiency is necessarily extremely low, since it is very rarely possible to arrange any research so that it will directly proceed to the end required.

(*To be concluded.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Dr. O. F. Hudson has resigned his post as lecturer and instructor in assaying and special lecturer in metallography in order to take up duties as assistant investigator to the Corrosion Committee of the Institute of Metals.

The degree of Doctor of Science has been awarded to the following: Elizabeth Acton (botany), Henry Briggs (mining), George William Clough and Albert Parker (chemistry).

LEEDS.—On the occasion of Degree Day on July 1 the vice-chancellor (Dr. M. E. Sadler) in the course of an address reviewed the position of the university, with special reference to the war. Of nearly fourteen hundred associated with the university who are on active service, fifty-one had received military distinction. The war has found the university able and ready to give the nation unforeseen and many-sided service, and the long vacation is little more than a name for those in the university who are doing scientific or administrative work in connection with the war. The war, Dr. Sadler remarked, has already enriched the university with a deepened tradition of fellowship in public service. In the years to come it will be called upon to prove the power of patient but imaginative investigation, of trained judgment, and of unjealous and patriotic energy in helping forward whatever will impart a finer quality to the social and economic conditions of the national life. Grateful mention was made of the recent benefaction of Sir James Roberts for the endowment of a chair of Russian language and literature—an act of international significance. As important and opportune would be the foundation of a professorship of Spanish language and literature.

Alluding to the future of the universities, Dr. Sadler said, whilst they must continue to work in intimate co-operation with the great local authorities and the Government, it must never be forgotten that the living power of their work will depend on their continuing free from mistaken, however well-meant, kinds of external interference. Germany has failed, in spite of her brilliant endowment of knowledge, to keep unsullied in her universities freedom of moral judgment in respect of some vital questions of duty to mankind and to the State. She has gradually and half-consciously undermined, by subtle pressure of State control and by inducements of official distinctions, independence of moral and political judgment in some of the teachers through whom that higher education is given. This should be a warning to us.

St. Andrews.—At the summer graduation ceremony on July 6 the honorary degree of LL.D. was conferred upon Mr. W. E. Clarke, keeper of the zoology department, Royal Scottish Museum, Edinburgh; Mr. C. T. Clough, district geologist, Geological Survey of Scotland; Dr. R. B. Don; Mr. L. R. Farnell, rector of Exeter College, Oxford; Dr. C. G. Knott, lecturer in applied mathematics, University of Edinburgh; Dr. J. Musgrove, Bute professor of anatomy, St. Andrews, 1901, 1914; and Prof. W. R. Scott, professor of economics, University of Glasgow.

Mr. Asquith stated in the House of Commons on July 10 that he does not propose to advise the appointment of a Royal Commission on Education. The Government is itself engaged in a comprehensive review of the system of education as a whole.

At the invitation of the Paris Academy the Imperial Academy of Sciences of Petrograd has appointed three of its members as delegates to the International Commission established on the initiative of the Paris Academy for the purpose of taking steps, after the war, of restoring so far as possible the library of the University of Louvain burnt by the Germans.

The recently established School of Slavonic Studies at King's College, London, wishes to form a special Slavonic library, and hopes for the sympathetic cooperation of Russian learned societies by donations of suitable books. This having been brought to the notice of the Imperial Academy of Sciences of Petrograd by the Minister of Public Instruction, the Academy at once expressed its willingness to contribute to the desired end, and directed that a catalogue of the Academy's publications be sent to the school with the request that a list be prepared of the works which it wishes to receive.

Numerous bequests to aid medical science in the United States are reported in a recent issue of *Science*. By the will of the late Dr. J. W. White, trustee of the University of Pennsylvania, and Prof. J. R. Barton, emeritus professor of surgery, 30,000*l.* is bequeathed in trust as a permanent endowment fund, the income to be used for establishing a professorship of surgical research in the medical department of the university. Two hundred thousand pounds will be available for use by the Washington University Medical School, with the opening of the new term in September, through the gift to the school of 33,200*l.* each by Mr. E. Mallinckrodt and Mr. J. T. Milliken, of St. Louis. One fund of 100,000*l.*, to be known as the Edward Mallinckrodt Fund, will be devoted to teaching and research work in pediatrics. The other fund of 100,000*l.*, to be known as the John T. Milliken Fund, will be devoted to teaching and research work in medicine. The funds will enable the medical school to employ physicians in these departments for their full time. The amount, in addition to the Mallinckrodt and Milliken donations, to bring the fund to 200,000*l.* has been given by the General Education Board. A movement has been inaugurated to secure at least 400,000*l.* additional endowment for Jefferson Medical College, Philadelphia. Mr. D. Baugh, founder of the Baugh Institute of Anatomy and Biology, subscribed 20,000*l.*, provided that an equal amount was raised on or before June 16. The executors of the estate of the late Mr. Emil C. Bundy, of New York, have paid over to Columbia University the sum of 20,000*l.* for research work in cancer.

Attention may be directed to the help rendered to manufacturers and business men for some time past by the librarian and staff of the City of Coventry Public Libraries. From time to time lists of recent books in technical chemistry, metallurgy, etc., are issued in printed form and circulated widely among those likely to be interested. In addition, lists are prepared and issued dealing, *e.g.*, with a specific metal and its alloys. We have before us one such relating to aluminium, which gives an admirable series of references to original papers and books published in the last ten years. These lists are not only circulated among manufacturers and business men, but are also given a wider publicity by being pasted inside books on the same subject. The Central Library and its branches are well supplied with technical journals, to which the public have access without any restriction. The technical section is reinforced by cutting out the best articles from duplicate and unbound periodicals, mounting them on sheets, and exposing them in boxes where they are classified under appropriate headings. In addition, the staff of the library invites inquiries for information, whether made verbally, or by letter, or by telephone. All inquiries are treated as confidential, and no effort is spared to supply the fullest and most trustworthy information. No doubt the instance we have quoted is not unique, but it appears worth while directing attention to a practice which must be most helpful to the technical staff of manufactories, particularly where, as is so often the case, few, if any, technical books or periodicals are taken. The example of the staff of the Coventry Public Libraries is warmly to be commended.

SOCIETIES AND ACADEMIES.

London.

Challenger Society, June 28.—Dr. E. J. Allen in the chair.—Capt. Campbell **Hepworth**: The meteorology of Davis Strait and Baffin Bay, including ice distribution and frequency. The paper was based on a set of charts that had been prepared in the Meteorological Office.

Dublin.

Royal Dublin Society, June 20.—Dr. J. M. Purser in the chair.—Prof. W. H. **Thompson** and J. **Pimlott**: The possibilities of food production in the United Kingdom.—Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the years 1914 and 1915. The summer of 1914 was noteworthy for the great abundance of the "diamond-back" moth (*Plutella cruciferarum*) on turnip crops, both in the east and west of Ireland. Nymphs of the large shield-bug, *Tropicoris rufipes*, were very destructive to young apples in Co. Kilkenny in the summer of 1915. Another unusual observation was the abundance of two weevils, *Phyllobius argentatus* and *Strophosomus coryli*, on larch.

Royal Irish Academy, June 26.—The Most Rev. Dr. Bernard, Archbishop of Dublin, president, in the chair.—M. W. J. **Fry**: Impact in three dimensions. The paper showed that the course of impact in three dimensions can be minutely followed in the most general case. There are two or four directions (according to the value of the coefficient of friction) in which if sliding initially takes place it persists without change of direction, and of these alternate ones correspond to stable motions. Any other direction of sliding tends to get parallel to the adjacent stable direction, and does so if the impact is sufficiently prolonged, and at the same time the velocity of sliding vanishes, but does not if the direction is that special one along which sliding may take place, when

the velocity of sliding vanishes and rolling is impossible. In three dimensions the velocity of compression may vanish three times, so that before the first period of compression is over a second one may intervene. No matter how rough the bodies are, sliding may not cease, and the solution often given of impact between perfectly rough bodies may be inaccurate.—H. **Kennedy**: The large ions and condensation nuclei from flames. An examination is made of the nature of the large ions and nuclei from flames, which seem to be identical with those studied by Aitken and occurring in the atmosphere. The rate of decay of ionisation in the case of the large ions from flames is found to be according to the law $dq/dt = -\beta q^2$, where q is the charge of one sign per c.c. and β a constant. The number of nuclei per c.c. was measured by Aitken's apparatus. It is found that the nuclei disappear according to the law $dn/dt = -\gamma n^2$, and the rate of disappearance seems to be the same whether the nuclei are charged or uncharged. The large ions carry multiple charges, and the value of the charge depends on the circumstances of production. The mobility of the large ion, so far as experiment has gone, seems to be the same in all circumstances of production. The mobility must, therefore, be independent of the charge. The formation of the nucleus does not depend on the presence of the charge.

EDINBURGH.

Royal Society, June 4.—Dr. J. Horne, president, in the chair.—Prof. A. A. **Lawson**: The prothallus of *Tmesipteris tannensis*. Tmesipteris and the closely-related Psilotum form a group the main interest of which lies in their phylogenetic isolation. Both genera are limited to the tropics and sub-tropics, Tmesipteris being found in the South Sea Islands, Australia, New Zealand, and parts of Polynesia. With the exception of certain important descriptions by Lang, our knowledge of the gametophytes and embryo of the Psilotaceæ may be regarded as a complete blank. Shortly after his arrival in Australia in 1913 Prof. Lawson learned that both genera were to be found in great abundance in the vicinity of Sydney. After careful search several specimens of the prothallus of Tmesipteris and one specimen of what is believed to be the prothallus of Psilotum were discovered. The present paper contained an account of the general features of these prothalli, including descriptions of the antheridia and the archegonia. Observations on the embryo were also made, but a full account is reserved for a later paper, when more material will have been obtained. As regards the structure of the archegonium, which bears no very striking resemblance to either Equisetum or Lycopodium, one is inclined to regard it as reduced. This is not surprising in a plant the sporophyte and gametophyte of which are both reduced and highly specialised in their adaptation to definite habitats.—Prof. E. T. **Whittaker**: On the theory of continued fractions. The paper gave a general process for expressing a continued fraction as a continuant, and showed how to express the differential coefficient of a continued fraction as the ratio of two determinants the constituents of which are definite functions of the terms of the continued fraction.

June 19.—Sir T. R. Fraser, vice-president, in the chair.—Prof. C. R. **Marshall**: The pharmacological action of nitric esters. The paper dealt mainly with the relation between the chemical constitution and pharmacological action of these esters. All that were investigated, except those of organic acids and their alkyl esters, caused dilatation of the blood-vessels. The quantitative effect of the fully nitrated esters of the polyhydric alcohols and the sugars was chiefly dependent on their solubility in aqueous media; that of nitric esters of monohydric alcohols was much less dependent on this property. The influence of different groupings was described, and the theory that the pharmacological action of nitric esters is wholly due to their reduction to nitrites was combated. Evidence of the formation of nitric oxide hæmoglobin was not obtained.—C. W. **Tyrrell**: On the petrography of the trachytic and allied rocks of the Carboniferous age in the Clyde lava plateaux. These rocks were shown to fall into four groups, viz.: (*a*) Albite Bostonites, A. Trachytes, and A. Keratophyres; (*b*) Bostonites, Trachytes, and Keratophyres; (*c*) Quartz Keratophyres and Felsites; (*d*) Phonolites.

NEW SOUTH WALES.

Linnean Society, April 26.—Mr. C. Hedley, vice president, in the chair.—G. I. **Playfair**: Oocystis and Eremosphæra (Algæ). The object of this paper is threefold:—(1) To give an account of all forms of Oocystis and Eremosphæra met with in New South Wales; (2) to direct attention to the polymorphism of Eremosphæra, and to its connection with Oocystis; (3) to supply the original descriptions and figures, so far as possible, of all published species and forms of the two genera.—Dr. J. M. **Petrie**: The chemical investigation of some poisonous plants in the N.O. Solanaceæ. Part ii.—*Nicotiana suaveolens*, and the identification of its alkaloid. *N. suaveolens* is the "native tobacco" of Australia, and the only endemic species. It is a troublesome weed in the stock country, sometimes referred to as poisonous, at other times as a good fodder-plant, readily eaten by stock. As only a very few among the eighty described species of Nicotiana are known to contain nicotine, the author examined plants from three different localities in the interior of New South Wales, and in all identified and proved the presence of nicotine. The amounts found were 0·035, 0·003, 0·004 per cent. of the fresh plants, or 0·124, 0·011, 0·015 per cent. of dried (at 100°) plants. It was calculated from the lowest figure stated that enough alkaloid is contained in half a pound of green plant to poison an ordinary-sized sheep.—A. A. **Hamilton**: The instability of leaf-morphology in relation to taxonomic botany. The principal factors affecting leaf-morphology are tabulated, and a summary of the more important alterations resultant from their agency are given. A series of examples (chiefly Australian) is submitted, illustrating the effect of environment on leaf-structure; and evidence is offered, in certain cases, demonstrating the development of heterogeny in the foliage of closely allied plants, using dissimilar contrivances as protective agencies against adverse conditions; and homoplasy in plants distantly related, but employing a common protective device.—J. H. **Maiden**: *Brachychiton populneo-acerifolius*, F. v. M., the crimson-flowered Kurrajong. The name was applied by the late Baron von Mueller to a tree, recognised as a hybrid between *B. acerifolius* and *B. populneus*, growing in a garden at Mulgoa. Plants of the parent species were then growing in the garden, but it was not certain that the hybrid had not been introduced as a seedling from elsewhere. Inquiries for similar plants have been widely circulated, and records are now given of examples growing in different localities; but, except in one instance, they are all cultivated plants, the history of which is unknown.—J. H. **Maiden**: A Eucalypt hybrid (*Eucalyptus calophylla* × *E. ficifolia*). *E. calophylla* has white or creamy filaments, and *E. ficifolia* bright scarlet. Plants of a

more or less intermediate character, with rose to crimson filaments, are now in cultivation; and these are regarded as hybrids.

QUEENSLAND.

Royal Society of Queensland, May 1.—H. A. **Longman**: The supposed Queensland artiodactyle fossils. In 1886 a series of teeth from post-Pliocene deposits on the Darling Downs, Queensland, was described by the late C. W. De Vis as artiodactyle, under the name of *Prochoerus celer* (Proc. Roy. Soc. Queensland, vol. iii., p. 42). Although the author suggested that the teeth denoted an alliance with the peccaries rather than with the true pigs, his statements were interpreted as evidence of the occurrence in southern Queensland of the Papuan *Sus*. The Darling Downs deposits have yielded such a harvest of marsupial remains (including Diprotodon, Nototherium, Thylacoleo, and extinct kangaroos and wombats) that this supposed exception aroused considerable interest. The results of an examination of the type specimens by Mr. Longman show that the tooth recorded as a lower incisor is identical with the left lower laniary incisor of *Thylacoleo carnifex*; that the upper incisors and paratypes closely correspond with the posterior incisors of Nototheroid marsupials; that the imperfect molar tooth has no affinity with the Papuan pig, and does not present sufficient evidence to warrant its designation as non-marsupial. This molar is of a somewhat similar type to the remarkable large premolar of Macleay's "*Zygomaturus trilobus*," the status of which is in doubt, and which was included by Owen in *Nototherium mitchelli*. The evidence for the presence of fossil artiodactyles in Queensland thus disappears, and a much-discussed question has been settled.

CALCUTTA.

Asiatic Society of Bengal, June 7.—Dr. N. **Annandale**: Zoological results of a tour in the Far East. The tour was undertaken chiefly in order to investigate the lake-fauna of certain districts in Japan, China, and the Malay Peninsula. Three large lakes were visited, namely, Biwa-Ko in the main island of Japan, the Tai Hu or Great Lake in the Kiangsu province of China, and the Talé Sap or Inland Sea of Singgora in the north-east of the Malay Peninsula. The first two of these are inland lakes, whereas the Talé Sap is a lagoon connected with the Gulf of Siam. Full geographical details are reserved for a series of faunistic papers. Twenty-eight species of fresh-water Lamellibranch shells are discussed, belonging to the families Mytilidæ, Arcidæ, Unionidæ, and Cyrenidæ. The species of polyzoa of fresh and brackish water discussed are mostly from China and the Malay Peninsula. Four new Spongillidæ (three species representing Spongilla and one Trochospongilla) were found in the Tai Hu, and three, two of which were already known, in the Talé Sap.

BOOKS RECEIVED.

Indian Forest Records. Vol. v., part 7. (Calcutta: Superintendent, Government Printing.) 2s. 3d.

Indian Forest Memoirs. Sylviculture Series. Vol. i., part i. Pp. iv+126. (Calcutta: Superintendent, Government Printing.)

English Landscape: An Anthology, compiled by M. Baring. Pp. 122. (London: Oxford University Press.) 1s. net

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. xxxviii. Fasc. 4 and 5. (Genève: Georg et Cie.) 5 and 7 francs respectively.

A Scientific German Reader. By H. Z. Kip. Pp. xii+445. (London: Oxford University Press.) 5s. net.

Compendio de Algebra de Abenbéder. By J. A. S. Perez. Pp. xlvii+117. (Madrid: E. Maestre.)

Hitting the Dark Trail: Starshine through Thirty Years of Night. By C. Hawkes. Pp. 191. (London: G. G. Harrap and Co.) 3s. 6d. net.

The Mentally Defective Child. By Dr. M. Young. Pp. xi+140. (London: H. K. Lewis and Co., Ltd.) 3s. 6d. net.

Studies in Blood Pressure, Physiological and Clinical. By Dr. G. Oliver. Third edition. Edited by Dr. W. D. Halliburton. Pp. xxiii+240. (London: H. K. Lewis and Co., Ltd.) 7s. 6d. net.

Department of Mines. Memoirs of the Geological Survey of New South Wales. Geology, No. 7: Geology and Mineral Resources of the Southern Coalfield, with Maps and Sections. Part 1—The South Coastal Portion. By L. F. Harper. Pp. xiii +410+plates xlvi. (Sydney: W. A. Gullick.) 15s.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. iii. Parts v. and vi. (Parts xxv. and xxvi. of the complete work.) (Sydney: W. A. Gullick.) 2s. 6d. each.

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THURSDAY, JULY 20, 1916.

THE FUTURE OF EDUCATION.

THE speech of Lord Haldane in the House of Lords on July 12, on the training of the nation and the necessity of preparing for the future, is a timely contribution to the momentous discussion of the question of the educational position of Great Britain, and especially of that portion of it identified with England. Our only regret is that while Lord Haldane was a member of the Government he did not see that decided steps were taken to remedy the defects to which he refers, and thus give us the strength needed to compete successfully in the rivalry of nations. When he was president of the British Science Guild he took an active part in asserting the claims of science and scientific education to fuller recognition by the State, and we looked naturally to the realisation of these aims when he was in office. Statesmen have yet to learn that it is their duty to lead the people, instead of waiting for a mandate from them. If industrialists have failed to take the fullest advantage of scientific knowledge and research, the omission is due largely to the indifferent attitude shown by the Government until recently towards these factors of modern progress.

Whilst giving due credit to the results of the Education Act of 1902, particularly in respect of its effect in improving the supply of secondary education, in breathing new life into the numerous endowed schools of the country, Lord Haldane is careful to point out that, despite the improvement which has been achieved, this feature of our educational system remains our weak spot. So long as the possibilities of secondary education continue to be, to so large an extent, undeveloped and unorganised, as regards number, accessibility, staff, and equipment, so long as most of the pupils in secondary schools do not remain after they are about fifteen years of age, the possibility of efficient and abundant university education remains an unrealised dream.

It is, Lord Haldane says, an appalling reflection that in this country 90 per cent. of our young people get no further education after the age of fourteen, not to speak of the many thousands who cease school attendance at a much earlier age, and he further states that between the ages of sixteen and twenty-five much more than five and a quarter millions get no further education at all. The number of students who enter the universities of England and Wales in each year is 18,000 from a population of 38 millions, whilst in Scotland, out of a population of four and three-quarter millions, the number who enter the universities annually is 7770. If, therefore, there was the same proportion of students to population entering the universities of England and Wales as in Scotland the number would be upwards of 57,000.

It may well be asked what chance have we against other nations which go on a different plan and thereby, to put the question on no higher plane, have the knowledge and the power to stimulate industrial capacity and activity. "What does education mean but the training of the whole nature in the widest and most comprehensive sense, so that the youth of the nation may be able when the time comes to turn, it might be to science, it might be to the humanities, or to any of the thousand and one subjects which are covered by the field of knowledge of the twentieth century?" It is an absurd travesty of the situation, in the controversy now going on as to the respective share of science and the humanities, especially the classics, in the sphere of education, to accuse the advocates of science of claiming that science shall have the dominating influence to the exclusion of the humanities. They plead that science and scientific training shall, having regard to the great advance in the knowledge of natural phenomena and of the constitution and potentialities of matter which has now been gained, and the great part which these discoveries now play in human activities and as contributories to human well-being, be accorded their due place in the scheme of education from the lowest to the highest grades and be accepted as an essential factor in the equipment of every educated man.

In defence of the attitude of scientific men on this question, we cannot do better than cite the words of Huxley, where he says:—

> Do not expect me to depreciate the earnest and enlightened pursuit of classical learning. I have not the least desire to speak ill of such occupations nor any sympathy with those who run them down. . . . Classical history is a great section of the palæontology of man, and I have the same double respect for it as for other kinds of palæontology—that is to say, a respect for the facts which it establishes as for all facts, and a still greater respect for it as a preparation for the discovery of a law of progress.

In addressing the students of the South London Working Men's College in 1868 he laments that—

> Literature is not upon the college programme, but I hope some day to see it there. For literature is the greatest of all sources of refined pleasure, and one of the greatest uses of a liberal education is to enable us to enjoy that pleasure. Education is the instruction of the intellect in the

laws of Nature, under which I include, not merely things and their forces, but men and their ways; and the fashioning of the affections and of the will into an earnest and living desire to move in harmony with those laws. For me education means neither more nor less than this. Anything which professes to call itself education must be tried by this standard, and if it fails to stand the test, I will not call it education, whatever may be the force of authority or of numbers on the other side.

This is how the question stands to-day, and it will be strange—not to say tragical—if it be not possible for the leaders of the nation, in view of the tremendous issues which lie before us, to devise the means of solving it without further delay so as to set up as "the ideal of a national educational system an organisation giving every single individual a chance to attain to a maximum of personal culture and social efficiency according to his natural gifts and the strength of his will."

Lord Cromer, in a speech following Lord Haldane's, remarked of Germany that "side by side with a great advance in national prosperity and scientific knowledge there had been a vast deterioration of character"; and he feared the same moral collapse for us "if not sufficient attention was paid to humanistic, particularly classical, education in this country." The association of science with crass materialism, and the suggestion that we must look to classical education to preserve our national character, are both presumptuous and misleading. Lord Cromer must know that until after the year 1900 the only way of access to the university in Germany was through the Gymnasium with a nine years' Latin course and a six years' Greek course. It would be more accurate, therefore, to seek the origins of the present war and of German barbarisms in classical education rather than in that of science. The diplomatists and statesmen who are responsible for the war have, almost without exception, been trained on classical lines; and they have called in the aid of forces provided by science, which must, however, not be made responsible for the ignoble uses to which its knowledge is put. Men who have had a scientific education have answered their country's call, and made the supreme sacrifice, just as readily as those trained in classical schools. To suggest that the British nature and the noblest characteristics of "an English gentleman" must have the flimsy classical teaching of public schools to cultivate them is a fallacy which will not bear a moment's serious consideration.

Lord Cromer's speech is just such a one as might have been made in support of Latin as a humanising influence, when, at the Renaissance, the humanists of that time were urging the introduction of Greek into the curriculum. In those days the humanists were on the side of the new learning, but now they range themselves against it, forgetting that education must take account of the demands and tendencies of the day. When placing utilitarianism in contrast with literary studies, and science against spirituality, it should be borne in mind by advocates of established methods that, at the time when the foundations of classical education were laid, Latin and Greek had a very definite utilitarian object—one as the international language of the learned, the other as the storehouse of mathematical and scientific knowledge.

The time is ripe for a great and fundamental change in our methods and means of education. Modern needs demand not only that science and scientific training should be given their rightful and due place in the curricula of all grades of schools and in the universities, but also the abolition of all restrictions which prevent the children of the nation from the enjoyment of school-life until fourteen years of age. Part-time instruction should be arranged within the normal hours of labour for those who have left school until the end of the seventeenth year at least, and, lastly, the status and rewards of the teacher should be raised and made more attractive. The Promised Land is in sight, and must be won. It lies with our statesmen to give effect to these imperative claims and so provide for the best development of the Empire.

THEORY OF CALCULATION.

Theory of Measurements: a Manual for Physics Students. By Prof. J. S. Stephens. Pp. vii+81. (London: Constable and Co., Ltd., 1915.) Price 6s. net.

A NATURAL but erroneous impression produced by the title of this book, "Theory of Measurements: a Manual for Physics Students," is that it has to do with apparatus such as is found in a physical laboratory; but actually, while occasionally some piece of apparatus is just mentioned, the book has but little to do with physical apparatus or its use. Measurements are supposed already to have been made, and then the "theory of measurements" comes in, and considerations of accuracy, probability, least squares, and scientific juggling generally are set before the reader. It is difficult to say that they are explained; they are stated.

After a short introductory chapter, in which the extreme accuracy of wave-length observations are referred to and contrasted with a crude determination of *g* by means of an extemporised simple pendulum, with the view apparently of giving some idea of the use of significant figures, the author discusses in the next chapter the theory

of probabilities, the weighting of observations, and the treatment of the figures obtained, but illustrations are deferred until after the chapter on the precision of observations. Some interesting subjects for discussion are appended. The last relates to gambling, and the views of Dr. Burnham, of Chicago, are quoted, who believed that if the laws of chance were taught to children in the schools, they would steer clear of the slot machine in early years, and later would shun the bookmaker and every other gambling magnate. Now, would they? Might not they, even though they had been taught that the value of the chance was only half what they were paying, come to that other conclusion—natural if they have imperfectly understood what they were taught—that the laws of chance are "all theory like the stars," and that with luck they might easily win a big prize?

The third chapter is on "the adjustment of observations," and here we find more pains taken to explain how observations in general and observations that are not exactly consistent in particular should be dealt with to obtain the best or most likely results.

In the chapter on "the precision of observations" the probability curve is treated graphically, and mean square error, average deviation, and probable error are explained. The next chapter, on the propagation of errors, perhaps most nearly touches the experimental work of the student, for here the relation of error of observation to error of result is discussed. After this, plotting and negligibility are the subjects of two chapters, in the latter of which the slide rule is taken as an example. The concluding chapter is on empirical formulæ and constants.

It will be seen from the tabular statement of the subjects considered that they are of the first importance to the experimentalist. At the same time, unless the student is made to appreciate well both the niceties of the experimental art and the matters dealt with in this book, the latter may, if imperfectly understood, be a source of danger. The student may not appreciate the futility of overloading a multitude of bad observations, subject of necessity to consistent errors, with sheets of least square calculations. If he has more aptitude for figures than for experiment, he may even delude himself into believing that his calculated probable errors really are probable errors. In such cases it is much more important to spend the time required for these calculations in improving his apparatus or varying his method so as, so far as possible, to avoid consistent errors. Two or three experiments really well conducted are worth far more than a multitude performed in a slovenly way, and no scientific juggling will give the multitude more value. The writer feels that this aspect of the general question is not sufficiently insisted on, and the book, in spite of its many excellent features, would be more valuable to the student if the author had condescended to give more attention to the actual operations of the laboratory and their relation to the consequent calculations. C. V. BOYS.

"SPOTTED FEVER."

Cerebro-spinal Fever. By Dr. Michael Foster and Dr. J. F. Gaskell. Pp. x+222. (Cambridge: At the University Press, 1916.) Price 12*s*. 6*d*. net.

THIS excellent and complete monograph of the much-dreaded disease, cerebro-spinal fever—dreaded because of its high mortality and incapacitating sequelæ—should prove of great interest not only to the members of the medical profession but to men of science generally.

The book is dedicated by the authors to the memory of their respective fathers, and on account of its careful, lucid, scientific, yet withal practical, exposition of the subject it is a worthy tribute to those two great founders of the modern school of English physiology.

The authors claim that this monograph has for its aim an attempt to bring together and correlate the clinical and pathological facts which they were enabled to accumulate during the epidemic of 1915 in the Eastern Command, and the views set forth are the outcome of clinical and pathological observations made in the wards, the laboratory, and the post-mortem room of the 1st Eastern General Hospital.

There are eleven chapters and two appendices, and the excellent plan of giving a summary in italics of the principal facts dealt with in each chapter is helpful to the reader. There are eleven excellent plates, eight of which are coloured. The work commences with an interesting historical account of the disease—largely a summary from the exhaustive treatise by Hirsch on Geographical and Historical Pathology. The first authentic account of an epidemic is that which occurred in Geneva in 1805. From the date of this, its first appearance, the disease was epidemic at various places both in Europe and America. Read in the light of modern knowlege of carriers in the propagation of disease, we can understand how this disease suddenly appeared and travelled according to no appreciable law.

Prior to 1915 cerebro-spinal fever in an epidemic form had been confined in Great Britain to the industrial centres of Scotland and Ireland. The authors point out that although the naso-pharynx is the location in which the specific organism is to be found, yet, according to their experience, it may be present without causing any marked inflammatory condition of the mucous membrane. Consequently, carriers may appear to be healthy persons; and it is not surprising, therefore, that when, in 1915, large numbers of soldiers were crowded into huts and billets with deficient ventilation and other favouring conditions, outbreaks of the disease should have occurred not only among the soldiers but also among civilians. Serious epidemics occurred at Salisbury Plain, Aldershot, in the London area, and in the eastern counties of England. A good account of the symptomatology, diagnosis, and treatment of the disease is given. Four excellent coloured plates illustrate the four distinct varieties of rash, and

the statement of the authors may be noted that in their 39 cases a rash was present in 22.

The symptoms due to the inflammation of the meninges, viz., severe headache, vomiting, retraction of the head and neck, stiffness of the neck, and the presence of Kernig's sign, are common to all forms of meningitis. But the presence of the rash, and the discovery of the *Meningococcus* (*diplococcus*) *intracellularis* in the cerebro-spinal fluid after withdrawal by lumbar puncture, constitute the essential differential diagnostic signs. Excellent photographs are given illustrating cases exhibiting the head retraction and Kernig's sign; also remarkably well-executed coloured plates illustrating the macroscopic appearances presented by the brain and spinal cord, and the microscopic appearances of the meninges and the cerebro-spinal fluid containing the *diplococcus intracellularis*.

Various statistics are quoted which appear to prove that the authors are right in asserting that frequent lumbar puncture is the most valuable therapeutic measure, and that it is not enhanced by subsequent intrathecal injection of Flexner's serum. In fact, they state: "In our somewhat limited experience the introduction of serum caused, for the most part, a decided aggravation of cerebral symptoms." An excellent chapter on the pathology of the disease follows, in which the authors discuss the channels by which the diplococcus passes from the nasopharynx to the subarachnoid space. This is followed by a chapter on changes in the cerebrospinal fluid and the cultivation of the meningococcus from it, from the blood, and from the urine. The last fifty pages are devoted to an exhaustive account of the epidemiology and bacteriology, in which are discussed the contagion direct from throat to throat, the mode of examination of carriers, and their treatment by isolation and local applications to the throat and nose. In conclusion, there is an appendix containing a remarkable example of the spread of the meningococcus from carrier to carrier.

A MONOGRAPH ON TICKS.

Ticks. A Monograph of the Ixodoidea. Part iii. *The Genus Haemaphysalis.* By Prof. G. H. F. Nuttall and C. Warburton. October, 1915. Pp. xiii + 349–550 + plates viii–xiii. (Cambridge: At the University Press.) Price 12*s.* net.

Bibliography of the Ixodoidea. Part ii. May, 1915. By Prof. G. H. F. Nuttall and L. E. Robinson. Pp. 32. (Cambridge: At the University Press.) Price 4*s.* 6*d.* net.

THE present part of this useful monograph deals with the fifty species and varieties of Hæmaphysalis recognised as valid by the authors. The distinguishing features of the genus are stated and discussed, and the difficulty is noted of finding, among the many negative characters in this genus, points which can be employed for differentiating the species. Nevertheless, the authors have succeeded in drawing up a helpful dichotomic key for the determination of the species. The species are then considered in turn, and, as in the two previous parts of the monograph, careful drawings are given of those parts which are of systematic importance. Interesting conclusions are reached from a study of the geographical distribution of the different species; *e.g.*, that *H. bispinosa* has almost certainly been imported into East Africa, and possibly into New South Wales, with Indian cattle. Only one species of Hæmaphysalis appears to be restricted to birds, whereas several species of Ixodes are found only on birds. The authors give a list of hosts on which the various species of Hæmaphysalis have been found, and discuss the condemned and doubtful species. An account is given of all that is known regarding the biology of six species, two of which have been proved to be the carriers of pathogenic protozoa, one especially—*H. leachi*—being known in many parts of Africa as the carrier of a fatal disease—canine piroplasmosis or malignant jaundice.

The bibliography (462 titles) contains references to, and in many cases short notes on the nature and contents of, papers which for the most part have appeared since the publication of the previous bibliography in 1911.

OUR BOOKSHELF.

Newsholme's School Hygiene. The Laws of Health in relation to School Life. New edition, rewritten for all School Workers, by Dr. J. Kerr. Pp. 352. (London: G. Allen and Unwin, Ltd., n.d.) Price 4*s.* 6*d.* net.

NEWSHOLME's text-book on school hygiene first appeared in 1887, and in 1912 it reached its thirteenth edition. That fact is sufficient evidence of the appreciation it has met with; but circumstances have not made it possible for Dr. Newsholme to continue to develop the work so as to keep it abreast of the rapid advance of the science of school hygiene and the extension of its practice which recent years have witnessed. Hence it became desirable that the text-book should be rewritten by one who, like Dr. James Kerr, has played a more prominent part in these developments. The result is a text-book possessing much merit, and embodying facts and opinions based upon a large amount of experience and research.

It seems from a perusal of the first paragraph that the book is more particularly designed for school-teachers, but to such it will be more satisfactory when Dr. Kerr is able in the next edition to bring his exceptional knowledge and experience to bear upon a fuller treatment of some matters of importance; for while the book is (generally speaking) well balanced in its treatment of the subject-matter, it is in places much too brief. To

give two instances: The practical guidance upon the diet of the school child is very scant; and the subject of the disinfection of school books and papers demands something more than the statement (p. 345) that "any practical results of treatment of books or papers require so much care that destruction is probably the best treatment for such infected things." If this pronouncement is warranted by Dr. Kerr's experience, it stands in need of some amplification, if only in view of his subsequent statement (p. 346) with reference to scarlet fever and diphtheria that "no case is on record where school material has been demonstrated as the cause of spread." Part ii. of the book stands much in need of more and better illustrations.

The Daubeny Laboratory Register, 1904–1915. *With Notes on the Teaching of Natural Philosophy, and with Lists of Scientific Researches Carried Out by Members of Magdalen College, Oxford.* By R. T. Günther. Pp. x+139 to 295. (Oxford: Printed for the Subscribers at the University Press, 1916.) Price 7s. 6d. net.

IN this volume Mr. R. T. Günther, fellow and tutor of Magdalen College, has furnished a supplement to the register of workers in the college laboratory already published as an appendix to his "History of the Daubeny Laboratory." It is, as the compiler states, a record of quiet achievement by men who have been trained in the science schools of Oxford, and it may well be commended to the notice of those critics who are accustomed to speak as if the neglect of science were characteristic of Oxford at the present day.

The lists, though naturally of chief interest to Magdalen men, contain many names of members of other colleges who have laid the foundation of future distinction in the historic buildings by the Cherwell. Among the records here given are those of R. T. Reid (Lord Loreburn), F. Jeffrey Bell, G. T. Prior, J. B. Farmer, G. A. Buckmaster, A. F. S. Kent, F. C. R. Jourdain, J. A. Gardner, W. A. F. Balfour-Browne, C. G. Douglas, C. H. G. Martin (all members of Magdalen), Lazarus Fletcher (as Millard lecturer), and F. Soddy. The book also contains a list of apparatus bequeathed by Daubeny, of much historic interest.

Mr. Günther's labours have not been confined to the mere preparation of lists and enumeration of alterations and enlargements. He has given incidental expression to views on the position of science in Oxford, which, as coming from a teacher of experience and success, deserve serious consideration. Many would agree with him that the ultimate success of students is not to be estimated by the awards of examiners. More questionable, perhaps, is his opinion that the establishment of the final honour schools early in the last century, engineered by a party in favour of one form of learning, exerted a sinister influence on other studies, including natural science.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Gravitation and Temperature.

As one had anticipated, Dr. P. E. Shaw has been well aware (NATURE, July 13, p. 401) of the surprising character of the conclusions to which his very refined and searching experimental investigation on the relation of gravitation to temperature had led him, and has recognised the possibility of other obscure causes being in operation.

He steers clear of collision with awkward facts, with much success, by the hypothesis that the gravitation between two masses depends, not on their individual temperatures, but on a mean temperature of the pair, the mean being reckoned in any way that makes the larger mass preponderant.

This hypothesis does, of course, set aside the Newtonian principle of mutual forces. For example, that principle postulates independent mutual attraction between every two elements of mass, unchanged by the nature or temperature of any material obstacle that may intervene between them: every delicate operation of weighing invokes this principle. Yet here the total amount of heat in the attracting pair, or something of that sort, is held to affect their attraction, while intervening obstacles are of no account.

Theoretical considerations are, of course, rarely competent absolutely to rule out a new phenomenon, however strange, provided it is on a small enough scale; their function is to make an analysis into its essential elements, and to formulate the points to be tested in order to arrive at rejection, or incorporation with existing theory. The main surprise in the present case is the very high value for an influence of temperature on gravitation that is obtained.

Cambridge, July 5. J. L.

The Great Aurora of June 17, 1915.

REGARDING the magnetic storm and the auroral display of June 17, 1915, referred to by Prof. Barnard and Father A. L. Cortie (see NATURE, vol. xcv., pp. 450, 536, etc.), it may be of interest to place on record the following facts. Independent reports presented by Mr. Tulloch, the meteorological observer, and Mr. Henderson, the wireless operator, at Macquarie Island, lat. 55° S., each mention the Aurora Australis of that date as the most brilliant noted in periods of one year and two years respectively. It was also the only occasion in two years when it was absolutely impossible to receive signals from any other station—even the high-power plant at Awanui, near Auckland (New Zealand), which seldom failed to make itself heard.

Mr. Tulloch's reports for three days were as follows:—

June 16, 9 p.m.—Barometer (corrected) 28·460 in., temperature 37·4° F., wind N.N.W., force 5 (Beaufort scale). Fierce gales in morning; fine clear night; slight auroral glow in the south.

June 17, 9 p.m.—Barometer 29·361 in., temperature 27·0° F., wind S.W., 7. Snowstorms continued throughout the day; three inches of snow on the ground. Squally S.W. winds and high seas. Barometer rising rapidly.

Brilliant red aurora. Looked something like a Japanese fan opening and closing. Its centre or base was a little north of the zenith and spread out from

about E.S.E. to W.N.W. The colours varied from bright green and purple to a deep red round the edges. The display continued all the evening, and at 10 p.m. it worked to the N.N.W., appearing to reach the northern horizon.

June 18, 9 p.m.—Barometer 29·658 in., temperature 27·8° F., wind S.W., 9. Snowstorms throughout the day with fierce S.W. gales. Brilliant aurora visible between breaks in the clouds.

Mr. Henderson reports:—

June 16, 8.40 p.m.—Very pale glow low down to the south.

June 17, 5.30 to 5.40 p.m.—Very vivid blanket form of aurora in the zenith, then a large red bank to the north-east very low and close, and red to the north; red fades and glow remains.

10 p.m.—Streamers and blanket form, and ring to the west and north.

The "atmospherics" heard in the wireless receiver varied in strength from 0 to 5 at intervals of about thirty minutes.

June 18, 9.20 p.m.—Sky nearly overcast, but bright glow visible overhead for a few minutes.

Although the auroral and wireless data appear to lack correlation, it may be of interest to note the circumstances under which the long and short waves (2000 m. and 600 m.) from Awanui, near Auckland, were received at Macquarie Island.

Of the six nights when both wave-lengths were recorded, the 600-metre wave was much the stronger on three nights when no aurora was seen; on two nights when the aurora was reported the longer wave-length was the stronger. On the remaining night the longer wave was again the stronger, but the sky was overcast and the moon approaching the full. An aurora, if there had been one, could scarcely have been seen in the circumstances.

H. A. HUNT
(*Commonwealth Meteorologist*).

Meteorological Bureau, Central Office,
Melbourne, May 24.

The Utilisation of Waste Heat for Agriculture.

IN the cheap generation of electricity the great problem must be how to secure and utilise by-products. With steam-driven stations the chief by-product is an abundant supply of hot water from the condensers, which in this country is looked upon as a nuisance to be got rid of as easily as possible. Would it not be possible to make use of this low-grade heat for agricultural purposes, so supplementing our all too scanty summers?

Power-houses burning 1000 tons of coal and upwards per week are quite common, and something like half of the heat generated by the coal is absorbed by the condensing water. It might be possible to heat fields by running the warm water through ditches, or perhaps better results would be obtained by running it through pipes buried in the ground. By this means large areas of land might be stimulated to produce much greater crops than have hitherto been found possible. It may be urged that the majority of existing power-houses are not in agricultural districts, so that the proposed experiment is not possible except in a few cases. To this one may reply that, in the near future, many large stations will be put down to supply current in bulk to vast areas. With the high voltage used for them the location of the power-house becomes a matter of wide choice, and it would be possible to put them in agricultural districts if this should prove financially worth while. The views of readers of NATURE on this point would be of interest. C. TURNBULL.

Electricity Works, Tynemouth, June 29.

SCIENTIFIC HORTICULTURE.[1]

THE periodic reports of the experiments conducted by the Duke of Bedford and Mr. Spencer Pickering at Woburn are always sure of a warm welcome by scientific horticulturists. It is true that these reports often give rise to controversy, and sometimes disturb the tranquillity of established horticultural belief; but if horticulture is to be a progressive craft both controversy and loss of tranquillity are to be welcomed.

The present (fifteenth) report covers a wide area of ground and records the results of observation and experiment on many subjects of importance to the fruit-grower. Among these subjects are: the fruiting of trees in consecutive seasons, injury to tree-roots in planting, ramming the roots of trees at planting-time, modes of planting and pruning. The observations on the alternation of fruitfulness and relative unfruitfulness support in a measure the view commonly held by fruit-growers that such an alternation exists, although the authors are inclined to attribute it rather to the effect of external conditions—for example, spring frosts—than to an internal rhythm.

For our part, we are convinced that if the alternation is to be ascribed—as in fact it may well be—to external conditions, those conditions are more subtle and complex than the authors' hypothesis suggests. As to the fact of alternate fruitfulness and barrenness exhibited by certain varieties of apple there can be no doubt. One of the most striking examples was published some years ago by the Dominion Horticulturist (Canada), and was cited in the *Gardeners' Chronicle*. The numbers are so remarkable that they may be repeated here. A single tree of the apple Wealthy yielded the following amounts of fruit:—

Year	10th	11th	12th	13th	14th	15th	16th
Gallons of fruit	33	0	52	2	93	0	111

Year	17th	18th	19th	20th	21st	22nd
Gallons of fruit	22	$96\frac{1}{2}$	$1\frac{1}{2}$	75	5	118

Such a record establishes the fact of alternation of fruitfulness once for all, and it is the business of the scientific horticulturist to discover the explanation why certain varieties exhibit this alternation and why others do not.

Although we are far from being able to give a sufficient explanation of this alternate fruitfulness and barrenness, yet it is by no means impossible to see the direction in which the explanation is to be sought.

Kleb's brilliant investigations show that the nature and amount of the raw and elaborated food materials at the disposal of a plant determine the formation of vegetative or reproductive tissues. In such fruit-trees as the apple the blossom buds are laid down early in the preceding year. If at the period of their development there is a large demand on the part of the setting and maturing fruit for certain food materials, and if the supply

[1] Woburn Experimental Fruit Farm. Fifteenth Report. Pp. 83. (London: Amalgamated Press, Ltd., 1916.) Price 2s. 3d.

of those materials is limited, the blossom buds may have to go short. This effect of one year will be manifested in the poverty either of blossom or of fruit—or both—in the following year.

The sequence of barrenness on fruitfulness is, of course, not confined to fruit-trees, but is of common occurrence in forest-trees also. It is to be hoped that this interesting inquiry will be pursued at Woburn, and that a more precise expression may be given to the somewhat sketchy views with which we have at present to content ourselves. In an earlier report (the ninth) the authors startled orthodox fruit-growers by announcing that the practice of trimming tree-roots before planting is a work of supererogation, and that trees planted with bruised (untrimmed) roots do rather better than those with which this trouble is taken. The experiments described in this report tend rather to point away from the conclusions reached earlier, for they indicate—in the case of apples, pears, and plums—that root-trimming shows a balance in its favour of 15 per cent. In another experiment (with apples) there was no advantage either way; but with bush fruits (red currants and gooseberries) the untrimmed showed an advantage of 16 per cent. in the former case and 5 per cent. in the latter.

It must, we think, be conceded that the authors have established their contention that root-trimming is unnecessary. Growers are conservative and will doubtless need further convincing. In America, however, fruit-growers appear to share the authors' view, for in the most recent work on the apple (by Mr. Albert E. Wilkinson) we read that the leaving "of clean cuts is not being emphasised so much as formerly." It is noteworthy in this connection that in the southern States what is known as the Stringfellow method of root-pruning is practised. In this system all the roots are removed at planting and only small stubs left.

Further experiments on "careless" *versus* "careful" planting, in which the roots are either bundled in or spread out carefully, lead the authors to conclude that the careful method is unnecessary. They hold also to their previously expressed conclusion that ramming the roots is beneficial to the growth of the tree. We do not remember whether the experiment has been tried under the somewhat drastic conditions of pot-cultivation—the pots would need to be strong—but we are inclined to think that only by some such means may this point of practice be established beyond cavil. All are agreed that firm planting is necessary; the point on which growers are not at present convinced is the beneficent effect produced by such drastic ramming as is likely to injure the roots.

In expressing our gratitude to the authors for their valuable researches we would venture on the suggestion that the time has come for the publication of a full summary of the work at Woburn.

F. K.

THE ORGANISATION OF BRITISH CHEMICAL INDUSTRIES.

THE term "chemical industry" includes so many diverse interests, many of which are relatively small, that hitherto no joint action has been possible, and the smaller firms in particular have not been in a position to take advantage of the modern progress of science. There has been intense competition between neighbouring firms, and consequently great secrecy as to methods and results. All this must be changed in the future if the competition of enemy and friendly States is to be met successfully; British firms with kindred interests must unite and pool their resources instead of competing. The position to-day of those branches of the chemical industry which are highly organised shows that foreign competition can be encountered and defeated, and that the knowledge how to organise for success is not lacking in this country.

The formation of an association of British chemical manufacturers under the auspices of the most progressive chemical manufacturing firms in the country is undoubtedly an event of the deepest significance for the welfare of the industry. At a meeting held in London on June 22 a draft constitution and rules were approved, and the following provisional committee elected:—

Dr. E. F. Armstrong (Joseph Crosfield and Sons), F. W. Brock (Brunner, Mond and Co.), Dr. Charles Carpenter (South Metropolitan Gas Co.), Dr. M. O. Forster, F.R.S. (British Dyes), J. Gray (Lever Bros.), C. A. Hill (The British Drug Houses), N. Holden (Hardman and Holden), C. P. Merriam (British Xylonite Co.), the Rt. Hon. Sir Alfred Mond, Bart., P.C., M.P. (Mond Nickel Co.), Max Muspratt (United Alkali Co.), Sir William Pearce, M.P. (Spencer, Chapman and Messel), R. G. Perry (Chance and Hunt), R. D. Pullar (Pullar's Dye Works), Dr. Alfred Ree (Society of Dyers and Colourists), A. T. Smith (Castner-Kellner Co.), the Rt. Hon. J. W. Wilson (Albright and Wilson).

The objects of the new body are very comprehensive. Broadly, the association aims to represent the chemical industry when dealing with the Government, to develop technical organisation, and to promote new industries and the extension of existing ones. In addition to the usual powers taken by trade associations, the objects enumerated include the promotion of industrial research, the encouragement of the sympathetic association of manufacturers with the various universities and teaching institutes, and the co-operation with any society having for its object industrial efficiency or the advancement of applied chemistry. The names of the members of the committee are a guarantee that the scientific side of the work of the new association will not be neglected, and, moreover, provision is made for co-opting to the committee four representatives of allied associations, such, for example, as the scientific societies.

The subscription, which is based *pro rata* on

the size of the subscribing undertakings, is sufficiently large to ensure that the association, if successful, will have ample funds at its disposal.

It is generally admitted that much remains to be done to bring about closer co-operation between science and industry, and it is therefore satisfactory to note that the new association proposes to arrange systematic conferences between manufacturers and teachers, at which the methods of teaching and the production of the particular type of trained man which manufacturers desire for their laboratories and works can be discussed.

PRINCE BORIS GALITZINE, For.Mem.R.S.

PRINCE BORIS BORISOVITCH GALITZINE died at Petrograd, after a short illness, on May 4/17 of this year, at the early age of fifty-four years. At the time of his death he was director of the meteorological service of the Russian Empire, which has its centre, in the winter, at the Nicholas Central Observatory, Petrograd, and, in the summer, at the Constantine Observatory at Pavlovsk, about twenty miles away. For that appointment he was chosen by the Imperial Academy in succession to Lieut.-General Rykatcheff, who retired in 1913 after many years' service.

Before his appointment he was a member of the Academy, to which he was appointed in 1894, sometimes acting as secretary, a professor in the University of Petrograd, and in charge of the seismological station at Pulkovo, which had been initiated by him, with the co-operation of Prof. Backlund, in November, 1906.

Born at Petrograd on February 18, 1862 (O.S.), Prince Galitzine was brought up at first abroad, and spent the eight years, 1880-1887, as a naval officer; he graduated in philosophy at Strasburg in 1890, and became Privatdocent in Moscow, and afterwards professor of physics in Jurjef, before his promotion to Petrograd in 1893. His earlier scientific papers were chiefly on the properties of gases and liquids, and the critical state, but his work covered also other branches of general physics. So early as 1887 he published, with General Rykatcheff, a handbook of meteorology, and later he organised, carried out, and reported upon the observation of clouds and other meteorological and hydrographical observations of the expedition of the Imperial Academy of Sciences to Nova Zembla in 1896.

He is, however, best known for his work in seismology, in which department of science he was a distinguished leader. He was elected president of the International Seismological Association at the meeting at Manchester in 1912. He designed the instruments which go by his name, and which are recognised as giving records specially adapted for the analysis of the various displacements of the solid earth, transmitted in the form of earthquake waves from one point to another of the globe.

A complete set of instruments of this type was presented by Prof. Schuster to the observatory at Eskdalemuir—the pair of horizontal recorders in 1911, and the vertical recorder in 1912. Prince Galitzine came to England with his wife in 1911, and made use of the opportunity to visit Eskdalemuir and supervise the erection of the horizontal pendulums there. Thereafter he took a paternal interest in the observatory. He visited it again at the time of the meeting of the International Association in 1912, and in the same year he gave a remarkable address to the meeting of the International Mathematical Association at Cambridge.

He received the degree of Sc.D. from the University of Manchester in 1911, and was only recently elected a foreign member of the Royal Society. His untimely death will be felt as a great loss by all who are interested in meteorological and geophysical subjects. His genius was undoubted. His energy and goodwill inspired confidence and commanded success.

NAPIER SHAW.

NOTES.

WE notice with very deep regret the announcement that Prof. E. Metchnikoff, foreign member of the Royal Society, died at the Pasteur Institute, Paris, on July 15, at seventy-one years of age.

THE death of Mrs. McKenny Hughes, wife of the Woodwardian Professor of Geology in the University of Cambridge, which occurred on the 9th of this month, will be widely regretted. She was the constant companion of her husband in his geological expeditions, not only in Great Britain, but also so far as to the Caucasus and western America, which they visited after meetings of the Geological Congress in Russia and in the United States. She took a keen interest in natural history, was a lover of flowers, especially the Alpine kinds, as was shown by the charming garden at their house in Cambridge, and had great artistic tastes, sketching admirably in water-colours. Sharing her husband's interests in geology and archæology, she joined him in writing the volume on Cambridgeshire in the "Cambridge County Geographies," and her hand may be seen in two drawings illustrating his paper on the Cae Gwyn cave in the forty-fourth volume of the Geological Society's Quarterly Journal. She made the mollusca, recent and subfossil, her special study, determining those found in that cave, and contributing an excellent paper on the subfossil contents of some Cambridgeshire gravels to the *Geological Magazine* for 1888. Her death takes away from Cambridge a lady of rare attractiveness and most valuable as a social influence, for she never flagged in helping her husband to make young geologists feel, as they passed through the University, that, great as was her love for the inmates of her home, she could yet find a place for them.

ECONOMICS has suffered a serious loss in the death of Capt. W. J. Mason, who was killed in action on July 3. Although only twenty-seven years of age, Capt. Mason, without contributing to the literature of economics, was making his influence felt, both as a lecturer and as a member of that rising school of economists which is devoting its attention to the social aspects and living problems of the science. Capt. Mason, whose experience was unusually wide, having been an examiner in the Exchequer and Audit Department, after a distinguished academic career at the London School of Economics, where he obtained both the Gerstenberg scholarship in 1911 and the

Gladstone prize, held for a time the position of tutor under the Workers' Educational Association, and afterwards accepted a lectureship at the University of Bristol, where he found that combination of learning and industrialism which naturally appealed to a man of his inclinations and ability.

THE issue of *Science* for June 23 last publishes the text of a Bill introduced by Mr. Newlands last March in the Senate of the United States, the object of which is to establish engineering experiment stations in the State colleges of the United States. The Bill was read twice, and has been referred to the Committee of the Senate on Agriculture and Forestry. The Committee of One Hundred on Scientific Research of the American Association for the Advancement of Science has passed a resolution recommending the passage of the Bill, and emphasising the untold value to American agriculture of the similar agricultural experiment stations already established by the State in connection with the colleges. The Bill provides that "in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with engineering and the other branches of the mechanic arts, and to promote the scientific investigation and experiment respecting the principles and applications of the mechanic arts," there shall be established under the direction of the State college in each State a department to be known as an "engineering" or a "mechanic arts" experiment station. The Bill provides also for a grant of 3000*l.* a year to each State for the purposes of such an experiment station. It is worthy of note in this connection that, according to the *Scientific Monthly*, these State, or land grant, colleges and the institutions of which they are a part received in 1914, from the United States, 500,000*l.*; from the States and from other sources, more than 6,000,000*l.* They have 9000 instructors and 105,000 students.

ANOTHER attempt is being made to rescue the stranded Antarctic explorers on Elephant Island. Last week Sir Ernest Shackleton left Punta Arenas in an auxiliary motor schooner of 70 tons, placed at his disposal by the British settlers in the Magellan Straits. The vessel was to be towed south so far as possible by a steamer lent by the Chilian Government. The prospects of a rescue are considerably better than in the attempt made in the *Instituto Pesca*, for the *Emma* is a wooden vessel, and so better suited for the work. Moreover, the probability of open water up to Elephant Island is greater this month than last, when the ice conditions were exceptionally severe. There is, however, a possibility of failure, for the vessel has not power to force her way into pack-ice, and as no time must be lost in effecting a rescue of Wild and his men, arrangements have been made by the British Government to dispatch a relief ship from this country without further delay. Meanwhile, the *Aurora* is being repaired by the New Zealand Government, and will leave Dunedin in December under the command of Mr. Stenhouse, her first officer, to fetch Mackintosh and his party at Cape Royds. There is no likelihood that the *Aurora* will find any difficulty in penetrating the Ross Sea, or that the men at Cape Royds are in serious straits.

THE Athens correspondent of the *Times* reports that a decree has been published whereby from 4 a.m. on July 28 Greece will adopt East European time, and will thus be two hours in advance of Greenwich mean time, and one hour in advance of Summer Time.

THE *Indian Forester* records with great regret the death in action (in Flanders) of 2nd Lieut. G. R. Jeffery, deputy conservator of forests, Burma. We learn that Mr. Jeffery was born on December 12, 1880, educated at Coopers Hill, and joined the Imperial Forest Service in 1902. He was a man of high ability and professional knowledge, and his death will be a serious loss to the Forest Department.

ON August 24–26 the third annual conference of the Society for Practical Astronomy will be held at the Bausch and Lomb Observatory in Rochester, N.Y. The president of the society, Mr. L. J. Wilson, extends the invitation to the meeting to all who are interested in astronomy. The observatory at which the meeting will be held is equipped with an 11-in. refractor constructed by the Bausch and Lomb Optical Company.

DR. J. C. TELLO, Mr. G. K. Noble, and Dr. L. S. Moss have left New York on a South American expedition on behalf of the Harvard Museum of Comparative Anatomy. Arriving at Paita, in Peru, they will travel on mules across the Andes and into the Amazon Valley, where they hope to collect zoological specimens and to study the tribe of Guanani Indians.

AN important ethnological expedition is about to be undertaken by Dr. R. H. Lowie, of the American Museum of Natural History. He will visit, first, the Crow Reservation in southern Montana, where he hopes to secure a thorough-going account of the war customs of the tribe and to complete a collection of myths and folk-tales. After spending a short time with the Arapaho, of Wind River, Wyoming, in order to re-examine their ceremonial organisations, Dr. Lowie will proceed to northern Arizona, where an investigation of certain problems connected with the Hopi will be carried out in considerable detail. The main points of inquiry will be the character and functions of the Hopi medicine-man, and the nature of the religious feelings underlying the ceremonial performances already noted by previous observers.

THE President of the Board of Agriculture and Fisheries has appointed Mr. Richard Brown, Walton Bank, Eccleshall, Staffordshire, to be a member of the Agricultural Consultative Committee.

THE wireless station on Dickson Island was to have been dismantled, but thanks to the timely and enlightened intervention of the Russian Naval Ministry, which is providing the necessary funds, its existence is saved, and it will be able to carry on work, not only of great scientific value, but also of practical utility for Arctic navigation, which is just now of special importance for Russia.

THE Prime Minister has appointed a Committee to consider the commercial and industrial policy to be adopted after the war, with special reference to the conclusions reached at the Economic Conference of the Allies, and to the following questions:—(*a*) What industries are essential to the future safety of the nation; and what steps should be taken to maintain or establish them. (*b*) What steps should be taken to recover home and foreign trade lost during the war, and to secure new markets. (*c*) To what extent and by what means the resources of the Empire should and can be developed. (*d*) To what extent and by what means the sources of supply within the Empire can be prevented from falling under foreign control. The Committee is composed as follows:—The Right Hon. Lord Balfour of Burleigh, K.T., G.C.M.G. (chairman), Mr. Arthur Balfour, Mr. H. Gosling, Mr. W. A. S. Hewins, M.P., Mr. A. H. Illingworth, M.P., Sir J. P. Maclay, Bt., the Right Hon. Sir A. Mond, Bt., M.P., Mr. Arthur Pease, Mr. R. E. Prothero, M.P., Sir Frederick H. Smith, Bt., Mr. G. J. Wardle, M.P., together with the follow-

ing gentlemen, who are presiding over the Board of Trade Committees on the position of important industries after the war:—Sir H. Birchenough, K.C.M.G., Lord Faringdon, Sir C. G. Hyde, the Hon. Sir C. A. Parsons, K.C.B., F.R.S., Lord Rhondda, and Mr. G. Scoby-Smith. Mr. Percy Ashley, of the Board of Trade, and Mr. G. C. Upcott, of the Treasury, have been appointed secretaries to the Committee.

For the first half of the present summer there has been a complete absence of seasonable weather, the conditions continuing most persistently dull, damp, and cool. The weather reports from the health resorts issued each day by the Meteorological Office scarcely show a temperature of 70° at any of the English stations. Very little sunshine has been registered, although the amounts are somewhat erratic, but the sun's rays have had little effect in raising the shade temperature. Since the commencement of the summer the amount of the rainfall is given separately for night and day, a matter of considerable interest, both scientifically and to the general public. Records are published from rather more than thirty English health resorts, but the June values are only complete for every day throughout the month from six stations. The night observations are covered by the Summer Time hours from 5 p.m. to 9 a.m., a period of sixteen hours, and the day from 9 a.m. to 5 p.m., a period of eight hours, so that the night period is double the length of the day. Notwithstanding that the day is only one-half the duration of the night the rainfall for the day is more than that for the night at all the six stations, except at Ramsgate, where it is only 32 per cent. of the total fall. At Felixstowe the day fall is 64 per cent. of the total; in London it is 62 per cent.; at Harrogate 61 per cent.; Worthing 59 per cent.; and at Leamington Spa 51 per cent. of the total rainfall. This great excess during the day is abnormal.

The names Hurter and Driffield (more familiarly "H. and D.") will be remembered as long as photography is studied, on account of the results of many years' work which they published about twenty-six years ago. Dr. Hurter, a Swiss, was the chief chemist, and Mr. Driffield the engineer, at Messrs. Gaskell, Deacon and Co.'s, of Widnes, now the United Alkali Company, and in their spare time they worked together on some of the fundamental problems connected with photography with such success that their names will always be associated with the subjects that they investigated. Their methods of expressing the character of negatives and of estimating the sensitiveness of photographic plates, of which the present "H. and D. numbers" are living examples, form an important section of their work. The recent death of Mr. Driffield, seventeen years after the death of Dr. Hurter, has given rise to a strong desire to commemorate their work done in the advancement of photography. A committee of the Royal Photographic Society is therefore arranging a scheme to this end, and it is asking for subscriptions for the purposes of: (1) The endowment of an annual Hurter and Driffield memorial lecture. (2) The publication in book form of their most important writings, together with desirable but hitherto unpublished matter. (3) Providing suitable accommodation in the house of the Royal Photographic Society for the original apparatus, together with MSS., notebooks, correspondence, etc., all of which have been bequeathed to the society by Mr. Driffield and handed over to it by his executors. Several generous donations have already been acknowledged by the hon. treasurer, Mr. W. B. Ferguson, K.C., 48 Compayne Gardens, South Hampstead, N.W.

In the Journal of the College of Science, Imperial University of Tokyo, for October, 1915, which has only recently been received, Mr. R. Torii publishes an elaborate article on the prehistoric population of Southern Manchuria. This paper, well furnished with photographs, describes a population of hunters and fishermen, who seem to have very slowly gained a knowledge of iron and were practically in the age of stone. The discoveries of flint implements were exceedingly numerous. The pottery with its decoration in encrusted nodules of clay, and often coloured in red, is particularly interesting. The clothing of these people consisted of skins with some textiles made of hemp and other fibres. In the kitchen middens in the neighbourhood of Port Arthur some decorative objects made of bronze, iron, and jade, probably imported, were found. Southern Manchuria offers a practically unworked field for archæological work, and the Japanese scholars who have undertaken the work of exploration may be trusted to make the best use of this favourable opportunity.

A good illustration of the direct relation which obtains between the play of animals and the vital activities of life, such as the capture of agile prey, the avoidance of their most formidable enemies, or conflict with rivals, is furnished by Mr. C. J. Carroll in the *Irish Naturalist* for May. Herein he describes the behaviour of the raven when attacked by the peregrine. On such occasions every effort is made to escape by flight, but if overtaken the pursued throws himself on his back, and opposes beak and claws to his pursuer, thus, time after time, beating off the attacker. So soon as the young of the raven are able to fly the parents put them through a course of training in these tactics, acting the *rôle* of the peregrine until efficiency is attained. "At first the young are stupid and clumsy, but they soon learn to avoid the onslaught by turning over and presenting their claws, or by rising high in the air."

Mr. J. H. Owen, in *British Birds* for July, continues his record of observations made on the nesting habits of the sparrow-hawk. In the present section he describes the behaviour of the hen at the nest, bringing out some extremely interesting facts. Thus, for example, he remarks that when the young hatch she does not take the egg-shells to a distance and drop them, as so many other birds do, but eats them while she broods. Great attention is paid to the sanitation of the nest, the fæces of the very young birds being carefully gathered up, and either swallowed, or thrown clear of the nest by a jerk of the head. Later they are able to eject them over the edge of the nest, and so relieve the mother of this task. Until the young are from twelve to fourteen days old all the food is brought to the nest by the male, who is promptly and unmistakably informed if he displays an excess of zeal in this matter. There is one point on which the author fails to make himself clear. This concerns his statement that as incubation proceeds the hen sheds down about the nest until, at hatching time, it is flecked with down, which is removed very soon after the young are hatched. Is this down naturally moulted or pulled out? Why is it allowed to accumulate, since it serves to direct attention to the nest, and why is it later so carefully removed?

The annual volume of the Kew Bulletin for the year 1915 has only just been published, although the concluding part was issued on December 24. Several articles of economic importance will be found in the 438 pages comprising the volume. In particular, one on the gemination of coconuts, from which it appears that nuts taken from young trees may safely be

planted; another on the species of Sansevieria, the source of bowstring hemp, with numerous figures; and a third on Iburu and Fundi, two cereals from Upper Guinea, deserve particular notice. Of papers dealing with systematic botany, those on South African Santalacaceæ, the genus Meconopsis, new tropical African species of Ficus, and the genus Phelipea, a remarkable parasitic genus containing three species, are among the more important contributions.

In the Memoirs of the Department of Agriculture in India, vol. vii., No. 7, Mr. and Mrs. Howard and Mr. Khan contribute important papers on the Indian oil seeds, safflower and mustard. As in the Howards' earlier investigations into the economic plants of India, the various races have been collected and carefully studied at Pusa. Twenty-four types of safflower, *Carthamnus tinctorius*, L., have been isolated and separated on the characters afforded by leaves, bracts, flower-colour, and general habit. As a dye plant the safflower has only local importance, but it is interesting to find that some of the types which yield most dye also yield a high oil content in the seeds. Improvement by selection could be undertaken with ease as a result of the work done at Pusa, though it may not be an easy matter to establish a superior variety on a large scale. Not only may it be difficult to replace the country crop, but owing to the frequency of natural crossing in the plant, the deterioration of an improved variety would be very liable to take place.

Several important publications have been received from the Norwegian Meteorological Institute. The Jahrbuch for 1915 contains a summary of the meteorological observations of all the stations in Norway for the year 1915, including the station at Green Harbour, in Spitsbergen, which is maintained in that no man's land by the Norwegian Government. This station, in 78° 2′ N., is the most northerly permanent observatory in the world. The annual volume on the rainfall of Norway ("Nedbøriagttagelser i Norge") gives the rainfall and snowfall for nearly 500 stations for the year 1915, and includes a large-scale rainfall map in two sheets. A further pamphlet ("Oversigt over luftens temperatur og nedbøren i Norge i advet 1914") gives the monthly mean temperatures and the rainfall for Norwegian stations, with their departure from the normal, in 1914.

The May number of the Proceedings of the Tokio Mathematico-Physical Society contains a paper on the silver voltameter, by Mr. J. Obata, of the Department of Communications. In accordance with the specifications of the London conference of 1908 and of the Washington committee of 1910, the kathode was one of three platinum bowls, and the anode a plate of silver. After deposition the deposit was transferred from the bowl to the silver by electrolysis. Acidity of the silver nitrate solution was found to produce a decrease in the deposit of rather more than four parts in a million for an acidity near the kathode of one part in a million. With the help of two ohm coils previously standardised by comparison with the mercury ohm, the electromotive force of the normal Weston cell was found to be 1·01827 international volts at 20° C. The author recommends for ordinary laboratory work a silver voltameter in which anode and kathode are strips of silver bent into cylindrical hoops, the one of greater diameter being the kathode, placed in a glass dish, with a shallow glass dish below the anode to catch any particles of silver detached from it during the experiment.

In the development of the sugar industry the saccharimeter has been a noteworthy factor, because of the accuracy and simplicity with which, by its aid, sugar and sugar-products can be evaluated. Moreover, in recent years the instrument has been increasingly used for the purposes of general scientific research. It is therefore important that any questions regarding the accuracy of the fundamental constants of the apparatus, and of sugar polarimetry in general, should be critically examined, and any uncertainty respecting the basis of standardisation removed. In No. 268 of the "Scientific Papers" issued by the United States Bureau of Standards an account is given of investigations carried out with this object in view by Messrs. Bates and Jackson, who have studied the "constants" of the quartz-wedge saccharimeter and the specific rotation of sucrose. They find that pure sugar gives a reading of only 99·89° for the normal solution, instead of 100° as hitherto accepted. In other words, the "100° sugar point" was found to be rather more than one-tenth of 1 per cent. too high, thus making the proportion of sugar in specimens tested with the saccharimeter too low by this amount. The authors' result, if confirmed, is important, not only to producers of sugar, but to fiscal authorities, inasmuch as sugar is assessed for duty by means of the saccharimeter. The specific rotation of sucrose in solutions of normal concentration was found to be 66·529°, light of wave-length 5892·5 Å being used; this is a slightly higher value than that generally accepted, namely 66·502°.

In view of the abnormally high price of petrol and the difficulty of obtaining it, an article in the *Engineer* for July 7 will be read with interest. The article is descriptive of the Binks vaporiser and carburettor, by use of which paraffin may be substituted for petrol in motor-driven vehicles. A small petrol tank is fitted for the supply of petrol for starting the engine; paraffin is employed after the vaporiser has become sufficiently hot. The carburettor has two float chambers, one for petrol and the other for paraffin, and has a main jet and two pilot jets. The sprayed paraffin enters the vaporiser, which consists of two concentric tubes, between which the exhaust gases from the engine pass, and thus heat the walls of the inner tube. The latter tube contains a worm which causes the mixed air and paraffin to whirl as the mixture traverses the inner tube. There is thus a tendency to throw any unvaporised paraffin into contact with the hot walls, where vaporisation is completed. With present prices, application of this and similar devices may reduce the cost of fuel for motor-engines by 50 per cent.

The following books of science are to be found in Mr. John Murray's new list of forthcoming books:—"David Gill: Man and Astronomer," by Prof. G. Forbes; "Man as He Is," by Sir B. Fuller; "The Ages of Man," by C. Sayle; "What is Instinct? Some Thoughts on Telepathy and Subconsciousness in Animals," by C. B. Newland; "British Forestry: its Present Position and Outlook after the War," by E. P. Stebbing; "The Lost Cities of Ceylon," by G. E. Mitton, illustrated; "A Book-Lover's Holidays in the Open," by T. Roosevelt, illustrated; "Form and Function: a Contribution to the History of Animal Morphology," by E. S. Russell, illustrated; "Hunting Pygmies," by Dr. W. E. Geil, illustrated; "Vegetable Fibres," by Dr. E. Goulding (Imperial Institute Handbooks); and new editions of "Recent Progress in the Study of Variation, Heredity, and Evolution," by Dr. R. H. Lock, revised by Dr. L. Doncaster, with a Biographical Note by B. S. Woolf (Mrs. R. H. Lock); and "The Study of Animal Life," by Prof. J. A. Thomson, illustrated.

OUR ASTRONOMICAL COLUMN.

Origin of Group G of the Solar Spectrum.—In a preliminary note presented at the June meeting of the Royal Astronomical Society, it was announced by Messrs. Newall, Baxandall, and Butler that the group of lines in the solar spectrum marked G by Fraunhofer had been proved by them to be mainly due to absorption corresponding with the hydrocarbon band about wave-length 4314. The band in question is well-known from its occurrence in the "candle-flame" spectrum, where it appears in association with the "Swan" bands, and Lockyer's work has shown that it is the characteristic band of the spectra of undissociated hydrocarbons. The conspicuous presence of the band in the Fraunhofer spectrum is in striking contrast with its absence from the spectrum of the chromosphere as photographed during total eclipses, and further investigation of the details, which is in progress at the Solar Physics Observatory, will probably throw light on this important difference. The discovery of the origin of the G group will doubtless also be of considerable importance in connection with the interpretation of stellar spectra, as a gradual reduction in the intensity of the group on passing to stars hotter than the sun is a well-marked feature of the stellar sequence.

Variable Stellar Spectra.—In continuation of previous work on the spectra of Cepheid variable stars Mr. Harlow Shapley has recently obtained 150 spectrograms of representative stars of this class, using the 10-in. portrait lens and objective prism of the Mount Wilson Observatory (Proc. Nat. Acad. Sci., vol. ii., p. 208). The eleven stars investigated have periods ranging from nine hours to twenty-seven days, and include some well-known naked-eye variables, and some for which orbits have been computed from spectroscopic data. For some of the stars the place of greatest intensity of the general spectrum had already been observed to shift towards the blue on the approach of maximum luminosity, and it has now been proved in addition that the details of the spectra change with the phase of the variable, in accordance with the normal stellar sequence—that is, when the star is at maximum brightness, its spectrum corresponds to a higher stage of the spectral series than when at minimum. The change of spectrum was particularly easy of observation in the case of small dispersion spectra of the F type, where the variations in the relative intensities of $H\gamma$ and the G group were very marked; this is especially interesting in connection with the recent discovery that the G band is of hydrocarbon origin (see preceding note). As examples of the range of spectral variation the following may be noted:—δ Cephei, F2 to G3; RR Lyræ, B9 to F2; RT Aurigæ, A8 to Go. It is inferred that all Cepheids, including those of the cluster type, vary periodically in spectral class, as well as in magnitude and radial velocity.

A Large Meteor.—On July 8, at 11.59 p.m. G.M.T., a large meteor equal to Venus was seen at Bristol by Mr. Denning, and at Totteridge by Mrs. Wilson. The radiant point was at $22°+24°$, and the height of the object was from 77 to 51 miles. Its luminous course was 120 miles long, and observed velocity 32 miles per second.

The Extraordinary Meteoric Shower of June 28.—Mr. Denning has been endeavouring to collect observations of this event, but it seems to have been witnessed by very few persons. The sky was cloudy in the eastern counties of England, but all over the west, from Bournemouth to Fleetwood, the weather seems to have been favourable.

An observer living at Birmingham states that between 11 and 12 p.m. G.M.T. he saw nearly one hundred meteors, and that the radiant point was between the stars Eta and Zeta Ursæ Majoris. He describes the meteors as often dropping over the S.E. and E. horizon. They were frequently of a golden hue, with very short paths and moderately slow in their flight. Several of the larger meteors were bluish-white, and flashed out with startling suddenness and brilliancy, sufficient to render them visible through the cloud stratum which gathered in various parts of the sky.

Another observer at Bournemouth says that at 11 p.m. G.M.T. he noticed three bright meteors in about as many minutes, and that this rate of apparition appeared to be maintained until the early dawn.

This shower is certainly the richest which has been observed since the Leonid display of November, 1903, and being altogether unexpected and unknown increases its importance and makes it very desirable that it should be fully investigated. Possibly the orbit of some recent comet may be found to coincide with it. It is certainly curious that definite showers proceed from the same apparent radiant point in Quadrans on about January 2–3, March 27–30, June 28, and October 2, the intervals approximating three months.

NATIONAL INTEREST IN MINERAL RESOURCES.

The United States Geological Survey has issued its usual series of bulletins dealing with the mineral production of America in the year 1914. As pointed out in the introductory section, this compilation is the thirty-third of the published reports of the Mineral Resources Division of the Geological Survey, and thus enables comparisons to be instituted extending over a third of a century. The series is, however, rendered of still greater interest owing to the inclusion in it of an article by G. O. Smith, director of the Survey, on "The Public Interest in Mineral Resources." It need scarcely be said that this is written entirely from the American point of view; at the same time, it is very largely applicable to conditions in this country, because, as is well known, America and Great Britain stand practically alone amongst the world's great mineral producers in their system of mineral ownership. Everywhere the mineral resources of a country have been recognised since Roman times as originally the property of the State, to be administered for the benefit of the nation at large. The fact that the actual exploitation of its mineral deposits by the State is an unsatisfactory arrangement has been pretty universally recognised; there are a few isolated examples of such exploitation, which may succeed here and there under abnormal conditions, and the German Empire has carried this method further than any other State, but even in that autocratically governed country, where the working community is treated as a well-drilled machine subservient absolutely to the will of the ruling classes, State-worked mines cannot be described as successful. Apart from this ineffective method of dealing with their mineral wealth, States can choose between two very different, but both highly efficient, principles. Most of the great Continental States adopt the mining concession principle; under this the State retains for all time its absolute ownership of the minerals, but grants concessions to individuals or corporations under which these are allowed to exploit the mineral deposits upon payment to the State of a definite proportion of the

wealth so won in the shape of a royalty. This system is often described as a mineral lease, but the term is misleading, because a mineral deposit is a wasting asset, and cannot therefore be leased in the true sense of the word, which implies that the lessee should return his property to the lessor in unimpaired good condition at the expiry of the period of lease. The system may be more correctly described as a sale of the minerals as and when extracted, the purchase consideration taking the form of an annual royalty payment.

The other principle, adopted by the United States and by ourselves, is that of out-and-out alienation, from the very commencement, of the mineral deposit. With us this process of alienation has long been completed; in the United States it is still proceeding as fast as mineral deposits are discovered. The mode of tenure of the mineral deposits being, however, essentially the same, the greater part of Mr. Smith's remarks are perfectly applicable to conditions in this country. His point of view is indicated by two apt quotations, one from Gen. Halleck, who wrote in 1860, to the effect that mines "are by nature public property, and that they are to be used and regulated in such a way as to conduce most to the general interest of society." He also quotes Dr. R. W. Raymond, who, it may be remembered, gave evidence as to the American system of dealing with mineral lands before our 1889 Royal Commission on Mining Royalties, in which he showed that the policy which the United States had adopted, as best calculated to promote the national welfare, was "to get its mineral lands as soon as possible into private hands," and the quotation from Dr. Raymond's first report on mineral resources, written in 1868, is so particularly applicable to British conditions, and deserves so well the careful consideration of all interested—and who is not?—in our mineral resources, as to deserve reproduction here:—

"In view of these peculiar relations of mining, it is evident that Governments are, in a certain sense, trustees of the wealth stored in the mineral deposits of their realms—trustees for succeeding generations of their own citizens and for the world at large. It is not a matter of indifference to the citizens of this country whether our mining fields be ravaged and exhausted in one or even five centuries, when they might last a score."

At a moment like this, when we stand at the beginning of what promises to be an industrial struggle even more keen and bitter than the actual warfare to which we are now devoting all our national energies, those responsible for the government of Great Britain would assuredly do well to take some account of the huge wastage of our own national resources that is going on unchecked and almost unheeded, and to ask themselves with what measure of fidelity they are discharging their trusteeship.

Mr. Smith lays much stress upon the development that has taken place in every portion of the American mineral industry within the past thirty-three years, and upon the fact that the utilisation of these resources has resulted in a "higher standard of public service" by "giving all the workers a better opportunity to live a full life," this being, as he justly observes, "the ideal of democracy." He is a firm believer in the advantage of the system of alienation of mineral lands; as he says: "Both the past record and the present status of the mining industry show that the mineral resources of the United States possess largest public value in their indirect contribution to national development. . . . In fact, it may be easily shown that the State or nation will not be so much benefited through a direct royalty as through the indirect revenue gained by the establishment of a new industry, and by its influence on the neighbouring agricultural areas and the transportation systems to which the new traffic is tributary." He points out in some detail that the most equitable, as well as the most convenient, method of obtaining a direct return for the nation from its mineral wealth is by means of an income tax upon the profits realised by the miner; yet, as he is careful to add, "the public's direct share of the proceeds from mineral resources must not be so great as to affect unfavourably labor's opportunity or capital's incentive."

Few short articles have appeared within recent years that will better repay careful study by legislators and economists than will the article now before us. It needs neither justification nor corroboration; yet were such required, they may be found in most emphatic form in the statistical summary of the mineral production of the United States in 1914, issued simultaneously. To take only a few items, the production of the principal metals was:—

Pig iron	... ...	22,263,263 tons
Copper	... ...	1,150,137,192 lb.
Lead	... ...	512,994 short tons
Zinc	... ...	343,418 „ „
Nickel	... ...	845,334 lb.
Gold	... ...	4,572,976 oz.
Silver	... ...	72,455,100 „

Amongst non-metallic minerals the most important are coal, of which the total output was 513,525,477 short tons, and petroleum, with a production of 265,762,535 barrels. The total value of the mineral production of the United States is given as the enormous sum of nearly 2115 millions of dollars (say about 440,000,000*l.*), amounting to 21.40 dollars (say 4*l.* 10*s.*) per head of the population; the latter has practically doubled since 1880, whilst the value of the mineral production has increased nearly sixfold. It would be difficult to show such vast progress in any other similar field of human industry, and, though due in the first place to the wonderful natural resources of the United States, credit must also be given to the enlightened spirit in which these resources have been utilised. Our conditions in this country are, of course, widely different, yet there is no reason why we too should not strive to utilise what we have to the uttermost. Our need in this country is to realise and act upon the counsel which Mr. Smith embodies in one brief sentence: "The governmental duty to the mining industry first of all is to promote use without waste." H. L.

THE SMOKE NUISANCE IN THE UNITED STATES.

LIKE ourselves, the industrial centres of the United States are beginning to realise the serious economic and hygienic effects caused by the unscientific combustion of coal. In the Journal of the Franklin Institute for March, Dr. W. F. M. Goss has contributed a paper on "Smoke as a Source of Atmospheric Pollution," in which he discusses the results of a very elaborate investigation, extending over six years, into the consumption of coal and loss in the form of smoke in the city of Chicago, an inquiry undertaken under the auspices of the Chicago Association of Commerce.

He begins by summarising the general results of previous observers in regard to the effect of smoke on health, on vegetation, and on the loss and damage to property, and then proceeds to discuss in detail the sources of industrial smoke in Chicago and the extent of wastage.

The amount of fuel (excluding liquid fuel) consumed annually in the industrial area of the city is estimated at about 17½ million tons, and includes anthracite, coke, and bituminous coal, the last representing nearly one-half of the total. The following figures are given, though, as all experimental details are omitted, it is impossible to comment on the method by which they have been ascertained:—

Source	Coal consumed, tons	Average loss per cent.	Loss in tons	Percentage of total loss
Steam locomotives ...	2,099,044	1·084	22,750	7·47
Steam vessels	81,375	1·233	995	0·33
High-pressure boilers and public buildings.	7,316,257	0·805	58,867	19·34
Low-pressure boilers and private houses...	4,154,746	0 630	26,180	8 60
Gas and coke plant ...	234,551	—	—	—
Metallurgical and other furnaces	3,696,550	5·291	195,599	64·26
	17,582,523	1·808	304,391	100·00

The author discusses the causes of imperfect combustion and the best means of ameliorating the output of smoke; but as these are generally well known and recognised, at least in theory, they need not be reproduced. That smoke abatement is nearly always an indirect means of effecting economy is another well-established fact to which he refers. Dr. Goss points out the interesting observation, which may not be generally known, that the visibility or otherwise of smoke has no direct relation to its content of solid matter. The adoption of anthracite coal or coke as fuel will serve to render the discharge less visible, but will not eliminate the emission of dust or fine cinder. He appears to think that the replacement of coal by electrical energy will not reduce the amount of visible smoke to any serious extent, for steam raising will still be necessary. The more extensive use of gaseous fuel, smoke-washing, and electrical precipitation of smoke as a means of smoke abatement are passed over, for some unexplained reason, as not within the scope of the paper.

The author is not very optimistic in his outlook, for he considers that a revolution in practice which will result in the elimination of existing sources of atmospheric pollution is not to be expected "because present-day knowledge is insufficient to supply the necessary means, and, second, because the immediate application to all sources of pollution, even of such means as are now available, is mechanically and financially impracticable."

If by this statement Dr. Goss includes all forms of atmospheric pollution such as arise from gaseous impurities and dust particles blown into the air from the streets, etc., no doubt he is right; but he has himself shown that gaseous impurities are minimal in quantity, because they are rapidly dispersed, whilst dust particles, which exist everywhere, have never been regarded as causing injury either to animal or plant life.

But the really harmful constituents of a town atmosphere are unequivocally derived from one source—the incomplete combustion of coal, and there are few people who have studied the question in this country who are not thoroughly convinced that the pressure of properly instructed and firm control, supported by adequate legal penalties and the force of intelligent public opinion, would rapidly diminish and eventually eliminate an evil for which no economic or, indeed, any other excuse can exist. We are throwing away in a wanton and criminal fashion, without let or hindrance, a valuable inheritance which should belong to coming generations, and which they will never be able to recover.

J. B. C.

MAN AS A MACHINE.[1]

(1) A NUMBER of different experimental methods for determining the respiratory exchange of man have been employed in the past, some of which are designed for long experiments and some for short, and of late years it has become evident that a critical examination ought to be made with the view of determining how far the different methods give trustworthy and comparable results. A comparison of this kind involves very great labour, and Dr. Carpenter is to be congratulated on having undertaken the work. His investigation is throughout characterised by that careful attention to detail that we have learnt to associate with the Nutrition Laboratory at Boston of the Carnegie Institution.

The experimental methods examined in detail are the bed respiration calorimeter described by Benedict and Carpenter, two types of the Benedict universal respiration apparatus, and the apparatuses described by Zuntz and Geppert (the absence of the portable apparatus of Zuntz is perhaps a matter for regret), by Tissot and by Douglas. In addition, there is a description of accessory apparatus, including the Haldane gas analysis apparatus.

The experiments were made on resting subjects twelve hours or more after their last meal. In each experiment two of the different forms of apparatus were used either alternately or in series, the periods following each other as rapidly as possible. The three forms of Benedict apparatus were compared with one another, and the other methods were compared with the Benedict universal apparatus. Full tables of results are given, and these show that there is a wonderfully close agreement between the average figures obtained by the different methods.

In a critical discussion the author deals with the possible sources of error, as well as with the advantages and disadvantages of each of the methods.

In general comparable results can be obtained with all the methods investigated if care is taken, but preference is given to the Benedict apparatus, mainly on the ground that it is possible to obtain trustworthy results more quickly with it than with methods which involve volumetric gas analysis.

It would have lent additional interest to this discussion if a few comparative experiments could have been made during muscular work, as it is possible that some additional sources of error or inconvenience may become apparent when the different forms of apparatus are called upon to deal with a greatly increased respiratory exchange.

(2) The authors confine themselves in this publication to the calculation from the total respiratory exchange of the actual amount of energy liberated in the human body during walking exercise, but it is their intention to extend their observations in the future by means of direct calorimetry. An admirable introduction is afforded by an account of the previous history of the subject, amplified by an extensive table giving a complete summary of the results of previous observations.

The research has been conducted throughout in the laboratory on two athletic subjects. An ingenious form of horizontal treadmill is described, on which the subject walks at different paces, while the respiratory exchange is measured by means of the Benedict universal apparatus, various devices being employed for recording automatically the distance traversed, the number of steps taken, and the height through which the body is raised at each step.

[1] (1) "A Comparison of Methods for Determining the Respiratory Exchange of Man." By T. M. Carpenter. Pp. 265. (Publication No. 216 of the Carnegie Institution of Washington.) Price 2.50 dollars.
(2) "Energy Transformations during Horizontal Walking." By F. G. Benedict and H. Murschhauser. Pp. 100. (Publication No. 231 of the Carnegie Institution of Washington.) Price 1 dollar.

In attempting to estimate correctly the amount of energy used for the actual forward progression of the body it is essential to deduct from the total measured energy output a fraction which will represent what may be termed the basal maintenance metabolism, and it is somewhat difficult to decide what value to take for this purpose. The authors on the whole prefer to take as this basis the energy output found when the subject is standing still with the muscles relaxed, and this value certainly appears more reasonable than that found when the subject is lying at rest, though the latter has been used frequently by earlier workers on the subject. They have, however, considered other possible bases, especially with reference to walking at a very fast pace when pronounced movements of the arms occur.

With one of the subjects the pace was limited to slightly under three miles an hour, but with the other it was varied widely, ranging, roughly, from two and a half to five and a half miles an hour. As the pace increases the amount of energy output to move one kilo of the body weight one metre horizontally increases very greatly, as other observers have found.

Some experiments performed with the subject running showed that it was more economical of energy to run than to walk at the rate of more than five miles an hour.

In examining the influence of food on the energy output during the exercise, the authors find that the increase in the metabolism due to the walking is at any given pace in the main constant and merely superimposed on the increased resting metabolism due to the food. With a large protein diet there is evidence that the heat output per unit of work is increased. Apart from the question of the absolute expenditure of energy, the figures in the various tables will be of extreme interest to any who wish to study the character of the metabolism during muscular exertion.

C. G. D.

THE GRAVELS OF EAST ANGLIA.

THE Cambridge University Press has published two interesting geological pamphlets by Prof. T. McKenny Hughes, the first on "The Gravels of East Anglia" (price 1s.), the second entitled "Notes on the Fenland," with a description of the Shippea man by Prof. A. Macalister (price 6d.). The gravels of East Anglia are especially useful in any inquiry as to the age and origin of the superficial deposits of our country, because of their wide distribution and the long continuous sections on the coast, in which many of them may be studied. They consist for the most part of subangular flints, which cannot have been derived directly from the chalk, and Prof. Hughes concludes that they are the débris of an old Miocene land-surface on which the chalk with flints was exposed. After a well-illustrated account of many sections, and a brief discussion of the mammalian remains found in the gravels and associated deposits, Prof. Hughes summarises the sequence of phases in the later geological history of East Anglia as he now understands them. All these gravels are of Pleistocene age, but the marsh-deposits of the fenland are distinctly later. They contain remains of the brown bear and the beaver, which survived in England until historic times, but none of the typical Pleistocene mammalia; while the most remarkable of the birds is the pelican. There is no definite chronological succession which will hold throughout the fens, and the relative dates of the various remains found in them cannot be well determined. The human skull and associated remains from Shippea Hill, described by Prof. Macalister, may be quite modern, though perhaps as old as the Bronze age.

THE ORGANISATION OF INDUSTRIAL SCIENTIFIC RESEARCH.[1]

II.

IT is the common opinion of those who have to deal with the organisation of research that only a small percentage of all the investigations started are likely to be successful, the great majority being either dropped before they come to an end, or, being carried through, are filed simply as records, without any results having been obtained which would justify the expense of the investigation; that is to say, industrial research is justified only by the great value of the successful attempts, and these must bear the burden of a great number of unsuccessful attempts, which may have been quite as costly as the successful ones themselves. Naturally, the object of organisation is to attempt to reduce the proportion of unsuccessful investigations which will be undertaken, as has already been shown. This can be done by increasing the size of the laboratory, by increasing the specialisation of the workers, and especially by increasing co-operation between workers in different fields.

Naturally, the most important step which could be taken to increase the efficiency of industrial research would be to increase the likelihood of correct choice of a promising investigation, but, unfortunately, very little can be done in this direction. Those with the most experience in research work are all agreed that it is almost impossible to say whether a given investigation will prove remunerative or not. The only general conclusion that can be drawn is that the deeper a given investigation goes towards the fundamentals of the problem the more likelihood there is that the results will be of value, and the more superficial an investigation is, even although it appears more promising at first sight, the less likelihood there is that it will finally prove of real worth, so that the choice of investigations must necessarily be made largely at random, and will be influenced to a great extent by the ideas of the scientific workers themselves; if any worker has a desire to take up any particular line of work, provided that it is associated with the general trend of work in the laboratory, it is usually wise to let him do so, but the expedition with which a decision can be reached as to the probable value of the investigation after it has been started is very greatly enhanced by the complete co-operation of workers in the different branches of science in consultation on the problem.

At this point it might be well to discuss the organisation of a large research laboratory. Such a laboratory should be established in charge of a director who has had some actual manufacturing experience in the works processes, but at the same time he must have a considerable sympathy with purely scientific work and an interest in the advancement of scientific theory. *Both* these qualifications are desirable, but if such a director combining the two cannot be found, then a man of full scientific training should be chosen and put into a position of responsibility in the manufacturing side of the industry until he has become fully acquainted with the technique of the industry. It is most inadvisable to take a man from the industry who has not had a full scientific training, including advanced research work in academic problems, since he will generally be lacking in sufficient knowledge of, and sympathy with, the more academic investigations of which he will be in charge, and if the two necessary qualifications cannot be found united in one man, it will be necessary to take a man with the scientific

[1] An address delivered at Columbia University by Dr. C. E. Kenneth Mees, director of the Research Laboratory, Eastman Kodak Co., Rochester, N.Y. Continued from p. 413.

qualifications and give him the practical training, which is just as essential for the director of a laboratory as scientific knowledge.

These necessary qualifications in the director are reflected in the division of the laboratory itself into manufacturing and scientific sections, since the manufacturing section should be able to carry out on a small scale all the chief manufacturing operations, so that any investigations made in the laboratory can be carried through to the practical works' scale without interfering with the production departments. In the research laboratory of the Eastman Kodak Company the manufacturing department includes emulsion-making and plate, film, and paper-coating departments, the capacity being very considerable, the plate department being able to make 300 dozen 8 in. by 10 in. plates a day. These departments are used not only for systematic experiments on emulsion suitable for various purposes, such as different kinds of plate emulsion, colour-sensitive emulsions, especially for colour photography, and experimental printing papers, but they are further used to make cn a small scale products which are required for special purposes in very small quantities, such as special plates required by astronomers or spectroscopists, or special films required for experimental purposes by those working on colour photography, or attempting to develop other photographic processes. Requests for such special materials are received by every large manufacturing company, and the execution of the orders in the production departments frequently involves much delay and loss, whereas the manufacturing section of the laboratory can carry out the work with a full understanding of the use to which the materials are to be put, and can often materially assist the purchaser in working out his idea. Co-operation of this kind between the general public and the laboratory cannot but be of advantage to both parties.

The manufacturing departments should be in charge of skilled foremen who have had previous experience in the works, and be run in exactly the same way as the production departments themselves, being under the general supervision of the director of the laboratory and of any assistants that it may be necessary for him to employ. The foremen of the departments should, however, co-operate very fully with the scientific departments.

There is always some difficulty in a laboratory in getting the scientific departments to make full use of the special knowledge of the manufacturing division and at the same time to realise the practical difficulties which occur in works processes, but this difficulty can be overcome much better in the case of the manufacturing division of the laboratory than it could if an outside production department were involved without the laboratory division acting as intermediary.

The scientific division of the laboratory should be divided into departments dealing with the special subjects, but every care should be taken that these departments do not become at all isolated from each other, and that they co-operate with each other in the most complete way on the solution of the problems on which the laboratory is engaged. In order to ensure this the main lines of work under investigation may be suitably discussed at a morning conference at the beginning of the day's work, one day of the week being assigned to each subject. The laboratory organisation will then resolve itself into a number of different departments engaged in dealing with a number of different lines of work, and the total work of the laboratory during the year may be suitably represented by a chart similar to that devised for the research laboratory of the Eastman Kodak Company.

The departments of the laboratory are represented as circles on the outside of the chart, the main divisions in which problems group themselves being represented by rectangles, subdivided in some instances, occupying the middle of the chart. Each of these rectangles will correspond to a morning conference; thus, a conference will be held on general photography, at which there will be present members of the photographic department, the physics department, the department of organic chemistry, and the emulsion and coating or manufacturing departments. There will be present at the conference, in fact, every scientific worker of the laboratory, whatever his rank, who is directly engaged on the subjects which are included under the head of general photography, and in some cases, or on special occasions, members of the staff of the company external to the laboratory may be invited to these conferences, although as a general rule in the case of a large company it will not be possible for them to be regularly present. All the main lines of investigation should be laid down at these conferences, and the progress from week to week carefully discussed. This procedure will enable a great saving in time to be made, since it will avoid the loss of time which continually occurs in laboratories from the wrong man doing a specific piece of work; and the economy can be much increased by a suitable arrangement of the building and equipment itself.

The building should be so arranged that all the laboratories are open to everybody in the scientific departments, but that in each laboratory involving special classes of apparatus there are specialists continually working who are available for consultation and assistance to all other workers in the laboratory. In this way single operations which become necessary in the course of an investigation may frequently be transferred from the man who has carried on the main line of work on the subject to some other specialist in the laboratory. In the Kodak laboratory, for instance, electrical measurements, photometric measurements, spectrophotography, lens optics, photographic sensitometry, work involving dyestuffs, and all strictly photographic operations, such as copying, lantern-slide making, printing and enlarging, making up developers, etc., are in the hands of specialists, and whenever any of these operations become necessary in the course of an investigation, the conference directs that they be carried out by the specialist on the subject. In this way an organic chemist, for instance, will have the absorption curve of his products measured, not by an instrument in the organic laboratory, but by the physics department, while the preparation of photographs, lantern-slides, and prints, which are often involved in publication, are carried on by the photographic department and not by the man who did the work, these arrangements relieving specialists in one subject from having to acquire technical skill in another. It is in such complete co-operation that the greatest economy in scientific investigation is to be found.

It must be remembered that such specialisation as this is not at all suitable for use in a university, where the object is the broadening and education of the students; it is one of the many differences between research work in a university and in a set research laboratory, whether it be industrial or not, that in a university the primary object is the training of the worker, while in the research laboratory the primary object is the carrying out of the investigation.

The best utilisation of the results obtained in an industrial research laboratory is only second in importance to the organisation required to obtain them. All results of general scientific interest and importance should undoubtedly be published, both in the public interest, and because only by such publication can

the interest of the laboratory staff in pure science be maintained. It is doubtful if the importance of maintaining the full interest in theoretical science of a laboratory staff has been fully realised. When the men come to the laboratory they are usually interested chiefly in the progress of pure science, but they rapidly become absorbed in the special problems presented to them, and, without definite effort on the part of those responsible for the direction of the laboratory, there is great danger that they will not keep up to date in what is being done by other workers in their own and allied fields. Their interest can be stimulated by journal meetings and scientific conferences, but the greatest stimulation is afforded by the requirement that they themselves should publish in the usual scientific journals the scientific results which they may obtain. Another reason for publication is that when a piece of work is written up for publication the necessity for finishing loose ends becomes manifest, and that work which is published is therefore more likely to be properly completed.

With some laboratories publication is rendered difficult by the industrial organisation; while nominally manufacturing companies are usually willing that results of scientific interest should be published, the organisation of the company frequently requires that they should be passed on by the heads of several departments, such as the sales, patent, advertising, manufacturing, and so on, and the heads of these departments, possibly not understanding the subject, and being afraid of passing material which might prove detrimental, frequently err very much in the direction of withholding entirely harmless information from lack of sufficient knowledge. It is much more satisfactory, if possible, for one responsible executive to pass on all matter submitted for publication, and this will inevitably result in a much more liberal policy than where the responsibility is delegated to a number of representatives of different departments of the company.

In addition to these scientific papers special technical reports for the information of the staff of the company itself should be circulated by the laboratory, and in the case of the Kodak laboratory an abstract bulletin is published monthly giving information as to the more important papers appearing in the technical journals associated with the photographic industry and also of all photographic patents. It is often advisable, also, to prepare special bulletins dealing with the application of scientific investigations, which have already been published, to the special needs and interests of the company.

Since the evidence points, therefore, to the establishment of really large research laboratories as the most economical and efficient way of increasing the application of science in industrial work, the question arises as to how these large laboratories are to be supported. In the United States the great manufacturing corporations, who can afford the necessary capital and expenditure for maintenance, and are willing to wait for the results, have already undertaken the establishment of a number of large research laboratories. Such concerns as United States Steel, General Electric Company, United States Rubber, Du Pont de Nemours, and many others are supporting large and adequately equipped research laboratories, the staffs of which are engaged in work on the fundamental theory of the industries in which they are interested, and undoubtedly more and more such laboratories will be established in the course of the struggle for increased industry which the United States is preparing to wage. There are a large number, however, of smaller firms, who cannot afford the great expenditures involved, but who are anxious to benefit by the application of science to their work, and it seems that the only solution of the problem of providing for such firms is in the direction either of co-operative laboratories serving the whole industry, as has already been done in the case of the National Canners' Association and the National Paint Association, and no doubt in some others, or of national laboratories devoted to special subjects connected with industry and corresponding to such institutions dealing with special branches of pure science as the Geophysical Laboratory of the Carnegie Institution. Schemes for industrial scholarships tenable at universities do not meet the case at all, since work done under such arrangements must necessarily be directed towards a definite practical end rather than towards the general acquisition of knowledge connected with the underlying principles on which an industry rests. In the same way consulting laboratories, like industrial scholarships, are interested in the development of results for immediate practical application, and both these methods of work are substitutes for the practical industrial laboratories belonging to my second general division rather than for the large laboratories here discussed.

In England the co-ordination of industry has not proceeded as in the United States, and there are very few corporations who would be willing to maintain a large, fully equipped research laboratory of the type discussed, although a few such laboratories are well known to be in existence, but British industry has been brought very much together during the past eighteen months, and the organisation of industry is already a familiar phrase. Why, then, should England not establish a National Industrial Research Laboratory to assist all British manufacturers, and to develop the theory underlying the great fundamental industries on which British work depends? Such a laboratory could take the theory from the universities, or, where the theory was lacking, develop it and apply it to the separate industries, working out the results on a semi-manufacturing scale, and finally passing it on to the manufacturer. It may be of interest to glance at the possible size and scope of such an organisation, and I have attempted to formulate a scheme which will represent the minimum which would be required.

A laboratory on the smallest scale adequate to British industry would, at the beginning, require a staff of about two thousand men, one thousand of them scientifically trained and the other thousand assistants and workmen. It should have about three or four hundred men of the rank of professor or assistant professor in the universities, or of works manager or assistant manager or chief chemist in the factory. It would require land and buildings costing about 600,000*l.*, and its annual upkeep with allowance for expansion would be about 800,000*l.*

Vast as these figures are, they are infinitesimal compared with the value of the industries which they would serve. They represent a charge of less than 1 per cent., and probably not more than 1/5th per cent., of the net profits of British industry; moreover, after the initial period had been paid for, such a laboratory might be self-supporting, and might, indeed, finally make a very handsome profit on the original investment.

Suppose that such a laboratory patented all inventions and licensed manufacturers to use them, then, I think, it is not too much to expect that after the first five or six years it would be paying for itself, and that five years later it would be able to establish a great many subsidiary institutions from its profits; at any rate, such a vast laboratory would produce far more results at lower cost than would result from any other expenditure of a comparable sum of money on industrial research by the British industries.

I believe, however, that within the lifetime of most, if not all, of us we shall see such extensions of industrial research as will make all that we now have in mind seem insignificant, and it is because I believe so strongly in the importance of the subject that I have endeavoured to collect some impressions on the subject and to bring them before you this evening.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—At the assembly of faculties of University College on July 6, Dr. G. Carey Foster in the chair, the provost's report on the session 1915–16 was read. In addition to the services rendered in the Navy and Army by members of the college, laboratory and workshop accommodation has been utilised for various forms of war work. It is not permitted to give detailed particulars of the work done; but the departments that, from the nature of their work, have been particularly active are those of physics, chemistry, physiology, pharmacology, applied statistics and eugenics, and all the departments of the faculty of engineering. The effect of the war upon the college finances has been a cause of grave anxiety. This has been to some extent mitigated by a grant from the Treasury of 10,500*l.* and by the economies that it has been possible to introduce owing to the unsparing efforts of members of the academic staff in this direction, and owing also to the friendly co-operation of other London colleges, more especially King's and Bedford Colleges. The chief domestic event of the year is the occupation of the new chemistry laboratories. They are well on the road towards completion, but much equipment is still needed, and can only be provided as the means are forthcoming. Towards the sum of 20,000*l.* still required for this purpose, the benefactor, Sir Ralph Forster, to whom the college is largely indebted for the new chemistry buildings, has promised a sum of 5000*l.* provided the balance of 15,000*l.* is speedily subscribed.

The Executive Committee of the Household and Social Science Department of King's College for Women has appointed Miss Lane-Claypon to be the chief administrative officer of the department under the committee, with the title of dean. This office will be combined with that of lecturer on hygiene. The committee has decided upon this new appointment with the view of meeting the rapidly growing needs of the department. Dr. Lane-Claypon, who is at present an officer of the Local Government Board, will take up her duties next session.

Manchester.—The total number of students in all faculties for the session just concluded was 1165. In the sessions 1913–14 and 1914–15 the numbers were 1654 and 1415 respectively. The list of past and present members of the university serving with H.M. Forces in the war, or engaged in approved war service, now numbers more than 1300. The number of past or present members of the university killed in action, died through the war, or reported missing has now reached 90.

Many of the departments of the university have been able to render special scientific service, both advisory and experimental, in connection with the war. Prof. Petavel is a member of the Government Advisory Committee on Aeronautics, and all the work now being done in the department of engineering under his direction has a bearing upon war problems, and is being placed at the service of the Government. Prof. Dixon has been appointed deputy-inspector of high explosives for the Manchester area, and all the high explosives manufactured in the district are tested in the university chemical laboratory. Prof. Lapworth has been authorised by the Ministry of Munitions to conduct a number of war researches, and a staff has been organised in his department for testing tars made in various gasworks in the country. Prof. Edwards and his assistants in the metallurgy department have been fully engaged in testing work for the Admiralty.

Sir E. Rutherford is a member of the Board of Investigation and Research of the Admiralty, and special investigations are in progress in the physics department dealing with the problems that engage the attention of that Board. The testing of optical instruments for the Ministry of Munitions is also carried on in that department.

In the school of technology a large staff of teachers and students is engaged in various kinds of work for the Ministry of Munitions and other departments of the Government.

Prof. Chapman has been appointed by the Board of Trade, and Profs. Calder and Dickie by the Admiralty, for special service in these Government departments. War work is also being conducted in the botany department for the Royal Aircraft Factory, and by Prof. Beattie in the department of electrotechnics.

The women teachers and students have organised two V.A. detachments of the Red Cross Society, and have been engaged in other forms of work for the relief of the sick and wounded soldiers in the Manchester hospitals.

Several of the elementary schools having been taken over for military hospitals, the museum committee, in consultation with the education authorities, has made arrangements for classes of students to be given in the natural history and Egyptology departments of the museum. By this arrangement effective instruction is provided for 900 to 1000 children per week in the museum.

The next general meeting of the Association of Public School Science Masters will be held at Eton, under the presidency of Prof. H. H. Turner, on January 3 and 4, 1917.

The trustees of the Beit Fellowships for Scientific Research, which were founded and endowed three years ago by Mr. Otto Beit, in order to promote the advancement of science by means of research, have elected to fellowships for 1916–17: Mr. H. N. Walsh, Cork (extension for a second year); Mr. W. A. Haward, Tufnell Park; and Mr. C. C. Smith, Bristol. The three Fellows will carry on their respective researches in the Imperial College of Science and Technology.

The issue of the *Times* for July 15 gives some particulars of a meeting on July 6 between the parents of boys at twenty-six of the principal public schools and a committee of public school headmasters. The attitude taken up by some of the headmasters showed a misapprehension of the claims made by the champions of the value of a training in science in the education of all. To study science is not of necessity to become materialistic, and science and materialism are not by any means synonymous terms, though one headmaster argued as if they were. The man of science values as much as others high-mindedness and real character, but he urges that these may be secured side by side with an acquaintance with modern science and general efficiency. The headmaster of Harrow explained that in his school all boys are compelled as

part of their school career to learn science, and any boy with special scientific ability was encouraged to develop it. A wrong use may be made of many good gifts, and because modern research may be directed to destructive ends is no reason why our boys should leave school ignorant of subjects which will be essential in the coming economic struggle, and without a knowledge of which efficiency in the various departments of a modern State is impossible.

THE terrible conflict in which we, together with the chief civilised nations of Europe, are now engaged has served to awaken in this country a deep unrest as to educational results and methods, especially in respect of the place of science in education. This question formed the subject of a significant article by Prof. J. A. Fleming, F.R.S., in the Journal of the Royal Society of Arts for June 23. In this article Prof. Fleming seeks to lay the true foundations of national education for all classes of the people, and he demands that a careful and searching analysis shall be instituted into the causes which have led to our failure to cultivate sufficiently scientific knowledge and to estimate its proper place and function in general education. The true philosophy of education is to enable the child to educate himself, for he is naturally a philosopher, an experimentalist, and an artist, and the best we can do is to direct his activities into right channels, to teach him how to *do* things, and especially to bring the town-born child into closer touch with Nature. As to the secondary and public schools a complete change is demanded in the curriculum, even to the extent of the abolition in the latter of the present division into classical and modern sides, so that the various great groups of educational subjects—languages and literature; science, or a knowledge of the facts and laws of the universe; mathematics and graphics; religious and ethical instruction; history; economics; the duties of citizenship; and physical care—may be put upon a footing of strict equality in the school course. The right methods of scientific teaching applied to all branches of study, the importance of experimentation on the part of the pupil rather than that of much lecturing, the value of re-discovery, under due guidance, of the elementary laws and facts of science, are strongly insisted upon. So in the universities their function should be not so much the dissemination of scientific knowledge as the due training and instruction of men who can create new knowledge, it being the main duty of the university to increase by means of research the sum of knowledge based upon that already gained, opening up for the first time some novel and rich mine of scientific truth. Every encouragement should be given to men of original powers of mind, and we need to search diligently for such men in the firm belief that "there are revolutionising discoveries and inventions yet to be made which will affect human life in every way."

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, July 3.—Dr. Horne, president, in the chair.—Dr. R. **Kidston** and Prof. W. H. **Lang**: On Old Red Sandstone fossil plants showing structure, from Rhynie Chert Bed, Aberdeenshire. Well-preserved silicified plant remains have been found in a chert band not younger than the Middle Old Red Sandstone. There are two vascular plants, *Rhynia gwynne-vaughani*, n.sp. and n.g., and *Asteroxylon mackiei*, n.sp. and n.g. The plants of Rhynia grew closely crowded together, and their remains formed a peat. The plant was rootless and leafless, consisting entirely of a system of cylindrical stems. Rhizomes were fixed in the peat by rhizoids, and tapering aerial stems grew up from them. These stems bore small hemispherical projections, and branched dichotomously and laterally. They had a thick-walled epidermis with stomata, and a simple central cylinder consisting of a strand of tracheides surrounded by phloëm. Large cylindrical sporangia, containing numerous spores, were borne terminally on some of the leafless aerial stems. The plant is compared with some of the specimens of *Psilophyton princeps*, figured by Dawson; and a new class of vascular cryptogams, the Psilophytales, is founded for their reception. This is characterised by the sporangia being borne at the ends of branches of the stem without any relation to leaves or leaf-like organs. A comparison is made between Psilophytales and the existing class of Psilotales.—Dr. R. **Kidston**: Contributions to our knowledge of British Palæozoic plants. Part I.: Fossil plants from the Scottish coal measures. The paper contains descriptions of new or little-known species.—Dr. W. B. **Blaikie**: Exhibition of a universal sun-dial giving any standard mean time and of a diagram giving sunrise and sunset in mean time for all longitudes and latitudes. The dial was mounted equatorially, and was translucent, so that a shadow could be cast whether the sun shone from above or from below. A simple rotation set the instrument to the mean time for any longitude, and a tangent screw adjustment applied the equation of time with great simplicity. The diagram consisted of two ruled surfaces, of which the upper was transparent. When the graduation representing latitude on the one was made to coincide with the graduation representing declination on the other, certain radial lines gave the times of sunrise and sunset.—Prof. M. **Maclean** and D. J. **Mackellar**: On the heating of field coils of dynamo-electric machinery. Temperatures were measured by thermometers, by resistance measurement, and by thermo-couples placed at different points in the coil. Results were obtained for various conditions of load and for various speeds, and were discussed under the two heads: (1) the effect of the armature current, (2) the effect of armature peripheral speed.—Dr. M. **Kojima**: Preliminary communication on the effects of thyroid feeding upon the pancreas. The work had been carried out in the physiological laboratory of the University of Edinburgh. It was found that the addition of a certain amount of thyroid to the food of animals (rats) produced pronounced morphogenetic changes in the pancreas. After a few days' feeding, the gland cells multiply, their nuclei exhibiting marked evidence of karyokinesis. Accompanying this change there is a decided diminution in the amount of zymogen contained in the cells, which are now much smaller than normal. After two or three weeks the cell-multiplication ceases and zymogen again accumulates, so that the cells increase in size, a general enlargement of the gland being ultimately effected.—J. **Littlejohn**: The application of operators to the solution of the algebraic equation. The operators were differentiations and integrations with respect to the coefficients, and it was shown how the roots could be evaluated in the case of numerical equations.—Dr. H. **Bateman**: On systems of partial differential equations and the transformation of spherical harmonics. The paper showed how the general equation of wave-motion associated with Maxwell's electromagnetic theory could be transformed into the Laplacian form of equation in three variables. Thus the electrostatic vector **E** can be expressed in the form Grad V, where V is a solution of the Laplacian equation in terms of the variables X, Y, Z, which are functions of the original variables x, y, z, t. The result is that a solution of Laplace's equation in X, Y, Z is a solution of the wave equation in x, y, z, t.

PARIS.

Academy of Sciences, June 26.—M. Camille Jordan in the chair.—G. **Bigourdan**: The propagation of sound to a great distance. It is established that the cannonade at the front has been heard at a distance of 250 kilometres.—A. **Gautier**: The historical origin of the sugar-cane and cane-sugar. Cane-sugar was used in China in A.D. 749, and introduced into Japan a century later. It did not reach Europe until after the Crusades, and was grown in Spanish America in 1566.—L. **Landouzy**: Predispositions, innate or acquired, to tubercular infection.—Dr. Ramon y Cajal was elected a correspondant for the section of anatomy and zoology in the place of the late Jean Perez, and Prof. Morat a correspondant for the section of medicine and surgery in the place of the late M. Zambaco.—R. **Birkeland**: Some important formulæ and their applications.—N. **Lusin**: Research in primitive functions.—C. **Benedicks**: The determination of thermoelectric power by means of the differential galvanometer. The exact determination of the difference of temperature between two given points of a good conductor requires the use of two thermo-couples. If these are joined separately to the two circuits of a differential galvanometer, the difference of temperature can be obtained with greater precision than by following the usual method.—P. **Choffat**: Volcanic phenomena on the Portuguese coast north of the Tagus.—S. **Stéfanescu**: The origin of the lozenge-shaped figures of the dental plates of elephants (Loxodon).—Ch. J. **Gravier**: Incubation in *Actinia equina* at the island of San Thomé (Gulf of Guinea).

July 3.—M. Camille Jordan in the chair.—J. **Bergonié**: Powerful electro-vibrators working with small current, continuous or alternating. A resonance electro-vibrator. In a previous paper the author described an electro-vibrator for detecting and extracting fragments of projectiles, using from 550 to 950 watts, but, on account of the high self-induction, requiring 60 amperes at 200 to 220 volts. By compensating the self-induction with a capacity the power required can be much reduced. Thus in such a resonance electro-vibrator recently constructed, working on an alternating current of 110 volts, 42 periods, 7·5 amperes were taken, and its electromagnetic action is the same as that of an apparatus without a capacity, with a current of more than 100 amperes.—Dr. Boulenger was elected a correspondant for the section of anatomy and zoology, in the place of Prof. Waldeyer.—R. **Garnier**: Study of the general integral of equation (VI.) of Painlevé in the neighbourhood of its transcendental singularities.—E. **Gadeceau**: The submerged forests of Belle-Ile-en-Mer.—A. **Nodon**: Observations on the terrestrial electromagnetic disturbances.—A. **Lameere**: A new phase of Dicyema.—Ch. **Dhéré** and G. **Vegezzi**: Acid hæmochromogen.

BOOKS RECEIVED.

Laboratory Manual in General Microbiology. Pp. xvi+418. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Arithmetic for Engineers, including Simple Algebra, Mensuration, Logarithms, Graphs, and the Slide Rule. By C. B. Clapham. Pp. xi+436. (London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

The World and its Discovery. By H. B. Wetherill. Four parts. (London: At the Clarendon Press.) 1*s*. each.

Contents and Index of the Memoirs of the Geological Survey of India. Vols. xxi.–xxxv., 1884–1911. By G. de P. Cotter. Pp. iv+119. (Calcutta: Superintendent Government Printing.)

The Statesman's Year Book. Fifty-third Annual Publication. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xliv+1560+plates iv. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Shakespeare's England: An Account of the Life and Manners of his Age. Vol. i., pp. xxiv+546. Vol. ii., pp. x+610. (London: At the Clarendon Press.) Two vols., 25*s*. net.

Tales from a Boy's Fancy. By A. Shawmeker. Pp. 320. (Kansas City: Burton Publishing Company.) 1 dollar 50 cents.

A Manual of Mendelism. By Prof. J. Wilson. Pp. 152. (London: A. and C. Black, Ltd.) 2*s*. 6*d*. net.

The Dreams of Orlow. By A. M. Irvine, with an introduction by J. A. Hill. Pp. 256. (London: G. Allen and Unwin, Ltd.) 5*s*. net.

A Course in Mathematical Analysis. Functions of a Complex Variable, being part i. of vol. ii. By Prof. E. Goursat. Translated by Prof. E. R. Hedrick and O. Dunkel. Pp. x+259. (Boston and London: Ginn and Co.) 11*s*. 6*d*.

A Text-book of Physics and Chemistry for Nurses. By Profs. A. R. Bliss and A. H. Olive. Pp. xiv+239. (Philadelphia and London: J. B. Lippincott Company.) 6*s*. net.

A Modern Job: an Essay on the Problem of Evil. By E. Giran. Translated by F. Rothwell. Pp. 92. (London: Open Court Publishing Company.) 2*s*. 6*d*. net.

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THURSDAY, JULY 27, 1916.

THE NATIONAL AWAKENING.

WHEN the events of the early days of the South African war made men reflect upon the consequences of a conflict with a strong European Power, the nation was partly awakened from its sleep in the Garden of Ease. There were demands for the reorganisation of our forces for peace and war, and an incipient feeling prevailed that the plan of depending upon rule-of-thumb methods and knowledge acquired from endless mistakes—many of them painful—was not completely satisfactory. Over-prosperity was responsible for the lethargy into which we had fallen, and we began to learn in the school of adversity that modern struggles require strenuous preparation for success. With the end of the war, however, the stimulus subsided, and the nation again closed its eyes to the marvellous progress which other countries were making.

We have now been at war for nearly two years with the chief of these countries; and the consequent dislocation of trade and commerce has forced attention upon the ramifications of its influence throughout our Empire. It is realised now more than ever before that the development of our natural resources, and the profitable employment of our discoveries, have been left largely to the initiative of an alien people, and that there must be an Imperial Renaissance if we are to be independent of such enterprise in the future. We entered into the war in defence of international right against an aggressive military Power: we have to see that, when success has been achieved by our arms, the nation is fully prepared for the economic struggle to follow.

The recent activities of many national interests show that the need for a new Imperial policy is widely understood. Political parties have united to present an undivided front to the enemy; and whatever opposition exists to them has for its object the effective prosecution of the war and the promotion of industrial progress afterwards. We hope that the electorate will never again be deluded by the platitudes of the party politician of the pre-war era, and that the line of cleavage will be between obscurantism and progressive development. Commerce, industry, and education have ranged themselves with science to fight inactivity and inefficiency. Educational associations are endeavouring to produce reformed curricula and connecting links between school and university; trade associations and chambers of commerce are asking for the creation of departments of State which will promote the development of industry and research and co-ordinate their efforts; engineers, chemical manufacturers, and other productive bodies have organised themselves for the advancement of their particular interests; and scientific societies have formed a joint committee to deal with matters of national importance. All these bodies are separate organisations, though their aims are the same. It is obviously desirable that, while retaining their individual characteristics, they should, to give them political strength, come together in a single body like the British Science Guild, which represents the interests of education, commerce, and industry, as well as of science.

Without a unifying policy there is little possibility that a sufficient body of opinion will be created to carry into effect the reforms which are being advocated. A series of articles on "The Elements of Reconstruction," which began in the *Times* of July 17, traces the outlines of an economic principle by which "those who are attacking the problem of the industrial reorganisation of the Empire and those who are working for educational reconstruction" may be made to join hands. The State has already assumed full powers of reorganisation towards the scientific foundations of industries concerned with the provision of munitions of war: it should be induced to carry on the same policy after the war, and thus enable the nation to meet the competition of advancing rivals. In business the dominating influence is individual interest, and it will not be necessary to urge the advantages of education and science when the community as a whole really believes that they can be made creators of wealth. These agents must be brought into close connection with economic life if they are to have a decisive voice in national affairs. This does not mean that teachers and men of science should necessarily seek seats in Parliament, but they should associate themselves with any organisation which endeavours to secure supporters for measures designed to increase national efficiency by means of educational and scientific work.

The action of the State when it comes in contact with business must be determined by economic values and represent the action of the community as a whole in the conduct of modern business. The only way in which the community can advance as a whole is by an increase of the total production or an improvement in the quality of what can be distributed. To secure either of these things knowledge must be kept progressive; and, if wisdom is to control the State, provision

must be made for its development to the utmost. It is only by the introduction of these principles into the field of practical politics that the resources of the Empire can be fully developed, and we shall be able to hold our own against the competition of other countries, or maintain that supremacy which was obtained under entirely different conditions by rule-of-thumb methods and speculation.

Mr. Henderson, the President of the Board of Education, referred to the changing conditions, and the need for reform, in his speech in presenting the Education Estimates to the House of Commons on July 18. In the course of his remarks he said:

> The war is assisting in the creation of a greater body of public opinion in favour of a more liberal expenditure on education; and the essential importance of a comprehensive and efficient system of education on the progressive development of national life and the solidifying of the Empire is going to be more universally recognised. This principle must be encouraged and fostered, and on no account should the nation, in consequence of its expenditure on the war, be detained from bringing it into action.

The Government has decided to appoint committees to reorganise our whole system of education, and one of these committees will be concerned with the position of science. British educational endeavour has too often proved unproductive because of its haphazard character and its control by men out of touch with modern needs. A classical education at one of the fashionable public schools, followed by something very similar at an ancient university, accompanied probably by the pursuit of some branch of athletics and almost certainly by a continuous neglect of all branches of science, is the typical training of our statesmen and administrators. It is impossible for these men to know what scientific teaching means to the nation, or to understand the real difference between it and purely literary studies. Book-learning may be ornamental to the individual, but it is not of much practical value to a progressive community and is a danger when it prevents attention to scientific things. None of us wish the training of character to be disregarded in education, nor do we desire to depreciate the influence of literature, art, philosophy, and religion. But we have to safeguard our existence both in peace and war, and scientific knowledge is necessary to ensure this aim. The Empire is awake to the need for a policy which will correlate education, science, and industrialism for the benefit of all classes: if our statesmen do not respond to the call to action we hope that a new party of reform will arise to drive them into the wilderness.

SCIENCE FOR LIFE.

Discovery; or, The Spirit and Service of Science. By R. A. Gregory. Pp. x+340. (London: Macmillan and Co., Ltd., 1916.) Price 5*s.* net.

THIS book is the realisation of a long-cherished project, "une pensée de la jeunesse exécutée par l'âge mûr," its ambition being to make clear what science—and natural science in particular—aims at, what its human values are, and what spirit characterises the discoverer. We think that Mr. Gregory has done notable service in submitting his apologia at the present time, when the disposition to turn with expectation to science is probably more widespread than ever in the past, and we would congratulate him on the success with which he has stated his case. For while he hides no convictions, he has written temperately and good-humouredly, with such wealth of concrete and personal illustration that there is no hint of sermonising to offend. Perhaps the only passage in the book which betrays a trace of impatience—and we are not surprised—is one in which the author speaks his mind in regard to politicians. But it is all "good hunting," and the politicians will not wince at worse.

We admire greatly the restrained enthusiasm with which Mr. Gregory writes of the advancement of natural knowledge and of the great masters who have contributed to this, and the carefulness with which he gives chapter and verse from the history of science, so that even a prejudiced reader cannot but be impressed. Contributing greatly to the pleasant temper of the book is the author's evident sympathy with humanistic as well as scientific studies, and his clear recognition that if an antithesis is made there is something wrong either with the science or the humanism. It is ours to warm both hands at the fire of life.

Mr. Gregory is quite clear that scientific work is not confined to any particular body of facts or to any number of laboratories. As Clifford said, "there are no scientific subjects. The subject of science is the human universe—that is to say, everything that is, or has been, or may be related to man." "The work of science," Ruskin said, "is to substitute facts for appearances and demonstrations for impressions." These quotations are taken from a very interesting series (not of uniform value, we must confess), which occur as a sort of intellectual *hors d'œuvre* at the beginning of each of the twelve chapters.

"La République n'a pas besoin de savants," coldly remarked the president of the tribunal of French Revolutionists which condemned Lavoisier to death in 1793, and a "crime against the whole intellectual world" was perpetrated. In such measure as science is wilfully neglected and discoverers are starved or smothered in toil, civilisation remains impenitent, and it is part of the merit of this book that it presses the charge home. The fine chapter on "The Conquest of Disease" illustrates one side of the debt that humanity owes to science, and not less eloquent chapters on

"Scientific Motive" and "Practical Purpose" are very convincing. "Savoir c'est prévoir; prévoir c'est pourvoir." But there is no bowing in the house of utilitarianism, for the author takes such wonders of the modern world as wireless telegraphy, the telephone, the aeroplane, radium, antiseptics and antitoxins, spectrum analysis and X-rays, and shows most circumstantially that "each one of these things had its foundations in purely scientific work, and was not the result of deliberate intention to make something of service to humanity." In this connection we confess to being staggered by a remarkable quotation from the late Prof. W. K. Brooks; we like better one from Prof. A. N. Whitehead that "it is no paradox to say that in our most theoretical moods we may be nearest to our most practical applications."

In the very first volume of NATURE a strong plea was made on behalf of scientific discipline, and from time to time since powerful voices have urged upon the nation the imperativeness of paying more heed to the advancement and application of natural knowledge and to the cultivation of the scouting intelligence. Much has been done which it would be inaccurate and ungrateful to ignore, but still the people perish in thousands for lack of knowledge, and science, as Mr. Gregory says, is still too much the Cinderella in the house of education. It is valuable, therefore, that we should have in this book a judicial and factual statement showing not merely that natural science has given great gifts to mankind and put into our hands the keys to many doors, but that the mastery of some of its methods and the understanding of some of its principles are in themselves an educative discipline that cannot be attained in any other way whatsoever. We are glad that the author has gone a step further in insisting on the ethical value of learning to be a respecter of things and of habituating oneself to a high standard of accuracy.

In his references to the life and work of men like Galileo, Newton, Faraday, Darwin, Huxley, Kelvin, and Pasteur, the author illustrates the spirit of the discoverer—his fanaticism for the sanctity of truth, his disinterestedness and impersonal detachment, his delight in his work, and his cautious yet alert recognition of the possibility of error. As we read of the masters we feel a freshened conviction of the value of studies—far too rarely prosecuted—in the history of science. Much of the book is an eloquent commentary on the text: "The future of our civilisation depends upon the widening spread and deepening hold of the scientific habit of mind." And since the happiness of a people depends not a little on their capacity for the profitable enjoyment of leisure, we welcome the author's insistence on the inexhaustible delights of what our fathers called the pursuit of knowledge. It is man's prerogative to try to know Nature increasingly well, and it is certain that in proportion to his sincerity in this endeavour will be his enjoyment of her acquaintance.

Mr. Gregory has been well advised to dwell at considerable length on certain illustrations of the moods and methods of the discoverer, for the reader thus gets adequate concrete material on which to base an appreciation of his own. This greatly increases the value of the book. It has been quizzingly said that "the man of science appears to be the only man in the world who has something to say, and he is the only man who does not know how to say it." It is unnecessary to mention that Mr. Gregory, at any rate, must be exempted from this reproach, for his style is luminous and refreshing. We find, indeed, but one blemish in his work—that he does not tackle with sufficient directness the very interesting problem of the different kinds of discoverer, for there are certainly several distinct species which it would be profitable to have discriminated.

J. ARTHUR THOMSON.

MATHEMATICAL TEXT-BOOKS.

(1) *Arithmetic.* Part i. By F. W. Dobbs and H. K. Marsden. Pp. xv + 353. (London: G. Bell and Sons, Ltd., 1915.) Price 3*s*.

(2) *First-year Mathematics for Secondary Schools.* By E. R. Breslich. Fourth edition. Pp. xxiv + 344. (Chicago: The University of Chicago Press; London: Cambridge University Press, 1915.) Price 4*s*. net.

(3) *Mathematics for Machinists.* By R. W. Burnham. Pp. viii + 229. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s*. 6*d*. net.

(4) *A First Course of Geometry.* By Dr. C. Davison. Pp. 89. (Cambridge: At the University Press, 1915.) Price 1*s*. 6*d*.

(1) THIS text-book consists chiefly of sets of examples and test-papers, with some typical solutions. Detailed explanations are left to each teacher to give as he thinks fit. This has the double advantage of keeping the book within reasonable compass and at the same time including as much as any boy is likely to require, for boys do not, and probably never will, read long discussions in the text. But when revising or doing out-of-school work a certain number of specimen solutions are of real use. We like the general appearance of the book; there are numerous interesting and attractive questions, those on contours and map-reading deserving special mention.

(2) The author has drawn up a continuous course of algebra, geometry, and very simple trigonometry, suitable for a first reading. He claims that the fusion of these subjects in a single volume increases the interest of the students, enriches the content of the teaching syllabus, and emphasises the relation between the different subjects. The geometry includes simple properties of parallelism, congruence, tangency, and similarity; the algebra goes up to factors and quadratic equations. The book is printed in a most attractive form, and there are a number of excellent portraits of famous mathematicians, with interesting historical notes attached.

(3) The author of this volume has had consider-

able experience in the training of mechanics, and he remarks on the surprising number of cases where their knowledge of mathematics is limited to the first four rules. This naturally leads to an unintelligent use of formulæ and a marked inability to make applications to practical problems as they arise. The plan of this book is designed to meet these cases. It starts with the use of fractions and decimals, and includes chapters on percentage, mensuration, constructions, trigonometry, and some of a more technical character on lathes, threads, machines, gears, and business organisation.

(4) This small book includes the principal theorems of the first three books of Euclid. It is intended to be used after the ordinary introductory graphical course, and aims at giving the reader a bird's-eye view of a subject to be covered in more detail at a second reading. Those who are familiar with Dr. Davison's larger work will recognise a similarity of treatment in these pages. It would be an improvement if answers to the numerical exercises were given.

APPRENTICE TRAINING.

The Principles of Apprentice Training, with Special Reference to the Engineering Industry. By A. P. M. Fleming and J. G. Pearce. Pp. xiii + 202. (London: Longmans, Green and Co., 1916.) Price 3*s*. 6*d*. net.

Many interesting opinions are expressed in this book, but the same thing is repeated too often under different headings. The authors give particulars of the mode of selecting and training apprentices which was begun in 1913 at the British Westinghouse Company's works at Manchester; all the lecturers are either engineers or foremen, and many of the former are graduates in engineering. Men so chosen are not always good teachers, though they may be excellent as practical men; so future lecturers are being trained from among the apprentices under the supervision of the authors. So far the scheme seems to promise success. In October, 1915, there were 309 apprentices out of a total of 1348 youths in the works; the number of apprenticed boys is increasing. The course, while thoroughly practical, makes reasonable demands on the pupils' intelligence.

On the general question the authors give details as to the present inadequate methods of preparing for work in life both "specialists"—by which term they indicate repetition workers using automatic or semi-automatic machinery—and craftsmen, who need wider experience, skill, and intelligence. They point out that in the elementary schools book-learning is predominant; they show how inadequate is the time spent in manual training and other forms of "doing." They indicate that in the secondary schools most of the pupils are trained as though their main object in life was to pass the entrance examination to a university—although the percentage of such children who become undergraduates is small.

All this is but too true, and there is little likelihood that it will be changed so long as practically all the higher officers in the Board of Education and in the Civil Service generally are selected from those who have had a literary training. For science, modern languages, and manual work are regarded as forms of improper educational "specialisation," and Latin and Greek as the sole means for developing the character and intelligence of British youth; and this, although our naval officers, whose characters and intelligence most of us admire, are trained by means of mathematics and science, and have been deprived of the supposed indispensable benefits of classical training. J. W.

OUR BOOKSHELF.

A Bibliography of British Ornithology, from the Earliest Times to the End of 1912. By W. H. Mullens and H. Kirke Swann. Part i. Pp. 112. (London: Macmillan and Co., Ltd., 1916.) Price 6*s*. net.

We have not hitherto had an adequate bibliography of British ornithology, for the one by Elliott Coues begun thirty-six years ago was never, we believe, completed, and, excellent as was the first instalment so far as it went, it is, of course, now out of date. The bibliography upon which Major Mullens (who has already done work which may be considered as the basis of the present book) and Mr. Swann have embarked is of an ambitious and comprehensive nature. The aim of the authors has been to give a biographical account of each author of a separately-published work, followed by a bibliography of their works and of their papers contributed to journals bearing on British ornithology. Collations are given and spaced titles of books published before 1850; critical notes also on many books are included.

The first part of the book (of which there are to be six) has now been issued, and fully comes up to the promise of the prospectus. Even in this one part we meet with many books and authors with which few book-loving birdmen were probably previously acquainted. Under the heading "Anonymous" alone there are more than eighty items, and the present biographers have been very successful in hunting down the authors of these. The biographical notices are sufficiently full and, especially in the case of the older writers, very interesting. In fact, the book promises to be not only a very useful work of reference for British ornithologists, but also, what at first sight we might not expect, a very readable and entertaining book. It is well printed on very good paper.

An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators. By Prof. J. A. Fleming. Third edition. Pp. xiv+360. (London: Longmans, Green and Co., 1916.) Price 7*s*. 6*d*. net.

It is unnecessary to do more than refer very briefly to the third edition of Prof. Fleming's

book, as we have already reviewed the first editions in NATURE, and also, on two occasions, Prof. Fleming's more comprehensive treatise on wireless telegraphy. We ventured then to predict that both these books would become standard manuals on the subject, and our forecast is shown to have been correct by the recurring necessity for the issue of new editions. There is not much difference to be noted between the present volume and its forerunners, but certain additions have been made to bring it up to date.

No doubt when the present war is over much valuable experience which has been gained of the use of wireless telegraphy both in sea and land operations will, by degrees, become public, but one does not look for such information at present. It is to be hoped that this experience may be turned, in due course, to more peaceful ends, in which case one may look forward to a fresh edition of Prof. Fleming's book. In the meantime, it remains the best introduction to the subject for all students, and a sufficient manual for those who intend to take up the practical application, but who do not wish to go too deeply into the theoretical and mathematical side. The book is well and amply illustrated, though some of the process-blocks are not so clear as could be wished.

M. S.

An Inquiry into the Statistics of Deaths from Violence and Unnatural Causes in the United Kingdom. By Dr. W. A. Brend. Pp. v+80. (London: C. Griffin and Co., Ltd., 1915.) Price 3*s.* 6*d.* net.

THE object of this book (a thesis approved for the M.D. degree, University of London) is to examine the official statistics relating to deaths from violence and unnatural causes in the United Kingdom, to investigate their usefulness and the accuracy of the returns, and to suggest modifications in the present system.

Several different authorities (Home Office, Board of Trade, Local Government Board, Registrar-General, etc.) compile the returns, but the different reports do not seem to be co-ordinated. Thus during the same period the deaths from alcoholism in Liverpool are given by the Registrar-General as 36, by the Home Office as 113; the Local Government Board records deaths from "starvation and privation" as 94, the Home Office ("want and exposure") as 231, and the Registrar-General ("cold and starvation") as 146, and these instances might be multiplied!

More accurate returns are needed in many instances. The importance, for example, of trustworthy information concerning infant mortality from overlying and deaths of children from burning is obvious.

Dr. Brend's analysis shows that there are classes of deaths of which our knowledge, both statistical and otherwise, is seriously inadequate. At present, for example, the records of coroners' courts are practically inaccessible; the suggestion is made that all the records should be sent to a central office where they could be further analysed.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Universities, the Technical Colleges, and the Army.

A COUPLE of months ago it occurred to myself and the staff of the Heriot-Watt College that the first-year engineering course for the diploma would—with a few modifications—form an excellent preliminary scientific training for boys entering the Army who might hope for promotion to an officer cadet unit, the course at the same time still to remain an integral part of our diploma course.

The suggestion did not meet with local approval, but while thinking out the details, I also brought the matter before the Board of Education and the Association of Technical Institutions, where, I gather, it is meeting with some attention. I also found that similar suggestions had already been made by Mr. Darling in NATURE (January 20 and February 10) in some communications which I had missed, and also that a similar scheme was being carried out in certain English public schools.

Among those to whom I wrote was the Vice-Chancellor of Leeds University, and I have just heard from him that in his hands the whole scheme has taken a wider aspect, the idea being to devise courses of training which, while valuable as a preliminary scientific training for boys entering the Army, will at the same time be allowed to qualify as part of the course required for a university degree. It is on account of this wider aspect given to the matter by Principal Sadler that I venture to write to you on the matter.

The idea, which I believe originated with Lord Haldane, of drawing upon the universities for officers in the Army, and the establishment of the O.T.C., is no doubt a sound one. At the same time, at that stage the conception seemed to be to allow a student to go on with his ordinary university course while giving him in his spare time a certain amount of *military* training on the lines required by an officer.

It seems to me that among us we have evolved a much sounder conception of the duties of the university towards the Army, and that is, to give the boys such a *scientific* training as will be of value to them when they go to their special *military* training. There can be no harm in giving them a little drill, but the main object of the universities and the technical colleges should be to devote the time at their disposal principally to laying the foundations of the scientific knowledge of which modern warfare is an application.

A. P. LAURIE,
Principal.

Heriot-Watt College, Edinburgh, July 18.

The late M. Joseph Déchelette.

OF the many scientific men who have fallen in the present war none calls forth a deeper note of regret than the eminent and promising French archæologist and anthropologist, M. Joseph Déchelette, who was killed while leading his company to attack on October 4, 1914. A committee, embracing all the leading archæologists and anthropologists of France, has been formed "de conserver son effigie et de glorifier sa mémoire." The committee has secured the co-operation of the sculptor, M. Henry Nocq, to prepare a portrait plaque with, on the reverse: "L'épée moderne

de l'héroïque capitaine s'y croisera, au travers d'une large couronne de lauriers, avec le glaive de la grande époque gauloise que l'archéologue, a si bien fait revivre." Nor can one abstain from quoting from the circular, which has been sent out by our colleagues in France, the following sentence:—"C'est l'unité d'une carrière riche d'œuvres, plus pleine encore de promesses, que rappellera la légende: GALLIAE • RELIQUIAS ILLUSTRAVIT • PRO • GALLIA • MILES • CECIDIT."

There is not a British archæologist or anthropologist who is not indebted to M. Déchelette, and I am certain they will be only too glad to participate in a movement which has been rightly initiated by their French colleagues. Subscriptions should be sent to M. le Comte O. Costa de Beauregard, Sainte-Foy, par Longueville (Seine-Inférieure). Those sending a subscription of 10 francs are entitled to a replica of the plaque in bronze, those giving 50 francs to one in silver, and those giving 80 francs to one in enamel, should they so wish.

ARTHUR KEITH,
President of the Royal Anthropological Institute of Great Britain and Ireland.
50 Great Russell Street, W.C.

A Sunset Phenomenon on July 22.

AN interesting sunset phenomenon was visible here at 8.10 p.m. G.M.T. on Saturday last, July 22. Two very well-marked dark bands were seen rising from the south-eastern horizon across the pale pink counter-glow. On the north-western horizon the tops of two very distant cumulo-nimbus clouds were visible, the tops being about half a degree above the horizon; the clouds were dark against the sunset, but their upper edges were bright. The dark bands were the shadows of these clouds projected right across the sky. The shadows could be followed for some distance from the clouds, but were not visible in the plane at right angles to the direction of sunset. They were visible for quite ten minutes after I first noticed them, by which time the twilight arch was some way above the horizon and the dark bands rose from it. The two cumulo-nimbus clouds and a small patch of cirrus were the only clouds visible; their bearings were 302° and 305° respectively. An inquiry by telephone elicited the fact that no clouds were visible at Benson Observatory, and the cumulo-nimbus must have been at a great distance. It would be of some interest to know this distance, and I should be very grateful to any readers of NATURE in Herefordshire, Wales (especially Anglesey and the west coasts), and any part of Ireland roughly between Co. Dublin and Sligo and Donegal Bays, if they could let me know the character of the weather at the time mentioned, whether any cumulo-nimbus clouds were noticed, and especially if rain or thunderstorms were experienced, or even merely whether the sky was clear or cloudy. I fear the weather of a week ago is not often remembered, but it is possible that some of your readers may recollect it or have recorded it.

Had the clouds been more numerous the shadows would have encroached more on the sunset glow and on the counter-glow, and the appearance would have resolved itself into crepuscular rays, the explanation of which has been a matter of some discussion.

C. J. P. CAVE.
Meteorological Office, South Farnborough, July 24.

Silvanus P. Thompson as a Painter.

THE late Prof. S. P. Thompson was a man of such extraordinary versatility and power that his artistic side was scarcely done justice to in the Press. It may therefore be interesting to put on record what our friend, George Flemwell, the well-known painter, naturalist, and writer, living in Switzerland, says in a letter from Zermatt:—

"To my mind enough has not been said of his power for rendering ice in water-colour. I knew nobody to touch him in the painting of glacier ice at close quarters." (I believe Mr. Flemwell, himself a distinguished painter of Alpine scenery, has seen little of Edw. Compton's work.) "And his method was, considering the excellence of the result, the simplest and most direct I have ever seen. With the utmost care he worked with great quickness and facility. A few simple washes, and there was the ice: its form, its structure, and its quality. His values were right and his colour clean; he got the body and substance of the glacier. I am happy to think I have two or three pencil sketches I made of him when he was working on the Glacier d'Argentière and at the Mer de Glace; and I was with him when he painted the original of the Christmas-card of which you speak. . . ." H. S. T.

Bristol, July 17.

The Utilisation of Waste Heat for Agriculture.

MR. C. TURNBULL'S scheme (NATURE, July 20, p. 422) for artificially heating the soil, if feasible, would tend to encourage the insect pest. As all farmers and fruit-growers are aware, this has of recent years increased to an alarming extent. But for the seasonal lowering of the soil temperature it would become more serious still.

C. CARUS-WILSON.
Casterton, Kirkby Lonsdale, July 22.

THE INDIAN BOARD OF SCIENTIFIC ADVICE.

THE Report for the year 1914-15 of the Board of Scientific Advice for India consists almost entirely of isolated summaries of the work done during the year by the several scientific departments and scientific institutions of the Indian Government. As most, if not all, of these departments and institutions issue independent annual reports of their own, it is, to say the least, disappointing to find these technical summaries filling the report of a scientific body styled advisory; unless, indeed, the term "advice" be understood in the commercial or notificatory sense as merely indicating the existence in working order of these various departmental instruments of research.

The advisory proceedings of the Board occupy only thirty-seven lines of the 180 pages of the report, and all the information they afford is that the Board accepted the programmes of the several scientific departments, but would rather not have them in so much detail in future; and that it recommended (a) that officers attending the next Indian Science Congress should be regarded as on duty, (b) that a catalogue of scientific serials prepared by the Asiatic Society of Bengal should be published at the expense of Government, and (c) that experiments should be undertaken, as requested by the Punjab Veterinary Department, to determine the vitality of rinderpest virus under Indian conditions—all three mere departmental

matters that scarcely need to be referred to a special advisory board.

Of any far-reaching advisory purpose, of any great original directive enterprise, of anything in the nature of spontaneous movement, this report shows no record; one looks in vain for any reference to scientific education, or even for a connected account—as contrasted with bald, disjointed departmental summaries—of the general progress of science in India, vital affairs in which a Board of Scientific Advice might be expected to exercise a missionary influence, if not to take a commanding lead.

The simple fact is that, so far as the advisory business goes, this Report of the Board of Scientific Advice for India is a document of the *ex officio* genus; and it can scarcely be otherwise when the President of the Board is merely an *ex officio* hierarch of the Indian Secretariat, instead of being a man of science specially selected for his critical knowledge of scientific affairs.

ELIAS METCHNIKOFF.

ONE of the most remarkable figures in the scientific world passed from among us on July 15. Elie Metchnikoff, as they wrote his name in France, his adopted home, stands out as the type of a gifted, indefatigable investigator of Nature who, in accordance with his beautiful and earnest character, never faltered in his career, but from his boyhood onwards devoted himself to the minute study of animal life, and by a natural and as it seemed inevitable process passed through the study of the microscopic structure and embryonic growth of simple marine organisms to the investigation of human diseases and his great discoveries of the nature of the process known as inflammation and of the mechanism of "immunity" to infective germs and the poisons produced by them. By every zoologist in the world he was especially honoured and revered; for it was to him that we owed the demonstration of the unity of biological science and the brilliant proof of the invaluable importance to humanity of that delightful pursuit of the structure and laws of growth and form of the lower animals which he and we had pursued from pure love of the beauty and wonder of the intricate problems of organic morphology.

Just as his chief and friend, the great Pasteur, was privileged to proceed directly and logically in his own life's work, by his genius and insight, from the discovery of astonishing new facts as to crystalline structure—which seemed to have no bearing on human affairs—to the understanding (by the aid of those discoveries) of fermentation and infective disease; so did Metchnikoff himself both discover the activity and universality of the organic cell-units which he called "phagocytes," and at once proceed to demonstrate their prime importance in the process known as inflammation and the understanding of "immunity," which has revolutionised medical theory and practice.

Elie Metchnikoff was born in 1845 at Ivanavka, near Kharkoff. His father was of Moldavian ancestry and an officer of the Imperial Guard, from which he retired with the rank of major-general. He was devoted to the pursuits of a country gentleman, among which horse-racing was his special favourite. He had no tendencies to scientific study. Elie's mother, whose family name was "Nevakovitch," was a Jewess. He owed his mental gifts largely to her. From childhood he showed a strong taste for the study of Nature. After passing through the high school of Kharkoff he entered the university at the age of seventeen and completed his degree examinations in two years, when he went off (in 1864) to Germany for further biological training. He had already, in 1863, when he was only eighteen, published a paper in Reichert's *Archiv* on the stalk of Vorticella, and another on the nematode Diplogaster. In 1864 he published some observations on the Acinetarian Sphærophrya. After a brief sojourn in Heligoland he went to work in Leuckart's laboratory at Giessen, and accompanied the professor to Göttingen when the latter was promoted to that chair. In Leuckart's laboratory he worked at the parasite of the frog, *Ascaris nigrovenosa,* and made the important discovery of the fact that the hermaphrodite parasite of the frog's lung hatched from eggs gives birth viviparously to a free-living generation of males and females. This he published in 1865 in Reichert's *Archiv,* and a translation of his paper appeared in the *Quarterly Journal of Microscopical Science* in 1866. Leuckart claimed to have made the discovery "with the assistance of Herr Mecznikow," but Metchnikoff briefly stated that this was erroneous and that he alone had done the work in the absence of Prof. Leuckart and without his aid or suggestion. Naturally this terminated their friendly relations. In the same year he published some notes on those little-known microscopic animals, Icthydium, Chætonotus, Echinoderes, and Desmoscolex. This also was translated for the *Quarterly Journal* in 1866, and thus I became familiar with his name and the interesting character of his work, though I did not make his personal acquaintance until twenty-two years later, when (in 1888) Pasteur introduced me to him in his laboratory in the rue Vaugirard.

These papers were rapidly followed in 1866 by others showing his first-rate powers of accurate observation and originality, viz. on a European land Planarian; on the development of Myzostomum, the ecto-parasite of the feather-star, which he showed to be a modified Chætopod; on insect embryology (Hemiptera and Diptera); on the remarkable new rotifer, *Apsilus lentiformis*; and on the viviparous reproduction of the larvæ of the fly Cecidomyia. Then he sojourned for a time (1867) at Naples (before the days of Dohrn's Zoological Station) and wrote on the embryology of the cuttle-fish Sepiola, on the strange marine forms Chætosoma and Rhabdogaster, and in 1869 on Tornaria (which he showed to be the larva of Balanoglossus) and on the embryology of Echinoderms and of jelly-fish.

In 1870 he was appointed professor ordinarius

of zoology in the University of Odessa, and soon afterwards published papers on the embryology of Chelifer and of Myriapods. In the previous year he published an interesting paper on the little nematode parasite of fishes' gills—Gyrodactylus—and joined with that fine naturalist, Claparède, whom he met at Naples, in a paper on the embryology of Chætopods.

After his appointment at Odessa his work was interrupted by the illness and death from tuberculosis of his first wife, whom he had married in 1868. In spite of every care and a long sojourn in Madeira, whither he accompanied her, she died there in 1873. But in 1874 we find a paper by him "On the Eyelids of Mongolians and Caucasians," of considerable value to anthropologists, and in 1877 one of a bionomic character on "The Struggle for Existence between Two Species of Cockroaches—*Periplaneta orientalis* and *Blatta germanica*."

In 1875 he married his second wife, Olga Belocoyitoff, who was only seventeen years of age. She had just completed her studies in the "lycée" of Odessa, and attended after her marriage her husband's zoological teaching in the university. She survives him, and was his constant companion and ceaselessly devoted friend and helpmeet. She often aided him in laboratory work and by her knowledge of English and other languages, though her own special gifts, which she has cultivated to a high degree of excellence, are in painting and sculpture. From time to time she has published her own contributions to subjects which were occupying her husband's attention. The earliest of these is one "On the Morphology of the Pelvis and Shoulder-girdle of the Cartilaginous Fishes," published in the *Zeitsch. wiss. Zoologie*, 1880.

Metchnikoff holds an important place beside his great fellow-countryman and intimate friend, Alexander Kowalewsky (who died some years ago), in the establishment of what may be called cellular embryology and the investigation of the early stages of development of invertebrata by following out the process of cell-division and the arrangement of the early formed cells in layers. In the twelve years 1875 to 1886, when his last embryological paper was published, he produced many important memoirs on cellular embryology—namely, on that of calcareous sponges (in which he showed that the inner and outer primitive layers had been transposed in regard to their origin by Haeckel and Miklucko-Macleay); on that of jelly-fishes, of Planarians, of Echinoderms, of Ctenophora, and of Medusæ. These were accompanied by important theoretical discussions and suggestions as to the ultimate ancestral origin of the endoderm and the mesoblast. He also wrote on that curious group of minute parasites, the Orthonectids, and on insect diseases.

But the new departure in his fruitful career was approaching. It grew out of his observations on living jelly-fishes and sponges and on the transparent marine embryos of Echinoderms and the transparent floating mollusc Phyllirhöe. In 1882, owing to political disturbances in the University of Odessa, Metchnikoff migrated to Messina, the harbour of which is celebrated among zoologists for its rich fauna of transparent floating larvæ and adult glass-like Pteropods and jelly-fishes. Here he developed his views, already foreshadowed in 1880 (*Zoolog. Anzeiger*), on intracellular digestion exhibited by the amœboid cells of animal organisms, and published a series of papers in which the name "phagocyte" is first applied to these cells. In this, as in similar cases of discovery, neither Metchnikoff himself nor any of his friends claimed that he was the first to observe all the facts leading to his generalisation. He was *not* the first to witness the ingestion of foreign particles, of fragments of dead tissue, and even of bacteria, by the amœba-like cells of the animal body. He knew and cited the early observations of Haeckel on the ingestion of pigment granules by the amœboid blood-corpuscles of the sea-slug Tethys. He knew and cited the numerous observations on the activity of large amœboid cells in assisting the resorption or rapid destruction of other tissues in some special instances. He knew the observations of Jeffrey Parker and others on the intra-cellular digestion of food particles taken into their substance by the endoderm cells lining the digestive cavity of Hydra. He knew Koch's observation of bacilli within a colourless vertebrate blood-corpuscle, attributed by that observer to the active penetration of the blood-corpuscle by the aggressive bacilli. These and other like instances were all regarded as exceptional by their observers and not interpreted as evidences of a definite and universal activity of the amœboid cells of large physiological significance. Metchnikoff was acquainted with the remarkable discoveries of Cohnheim, Stricker, and others (in some of which I had a pupil's share during my stay in the winters of 1869-70 and 1870-71 at Vienna and Leipzig respectively). The pathological laboratories were full of observations and talk about the "diapedesis" and "outwandering" of the amœboid corpuscles in inflamed tissues, the origin of pus-corpuscles, and the activity of the amœboid cells in the stellate cavities of the frog's cornea and other connective tissues when stimulated. Metchnikoff put two and two together, and formulated the proposition that in all multicellular animals the main function of the cells derived from the deep or mid-embryonic layer between the dermal and intestinal lining layers is nutritional, and that they possess the power of ingesting and digesting—as does an amœba—solid particles, whether such particles are introduced from the outside or are parts of the organism which, owing to one reason or another, must be broken up and removed. The amœboid cells in connective tissues and in the blood and lymph are such eater-cells or phagocytes, as he now termed them.

He at once proceeded to explain the significance of these phagocytes and their utility to the organism, not only by pointing to their work as scavengers removing injured and dead tissue, to which

they are brought in hundreds of thousands by the process known as inflammation, but he also immediately gave first-class importance to their recognition by connecting them with Pasteur's great discoveries as to the cause of infective diseases by poisonous "microbes" which intrude into previously healthy organisms, and he further connected his generalisation with Darwin's theory of the origin of species by the natural selection of favoured races in the struggle for existence. He published in 1884 an essay entitled "The Struggle of the Organism against Microbes," in which he maintained the thesis that the phagocytes, universally present in multicellular animals, have been developed and established by natural selection in the animal organism as a protection against intrusive disease-causing bacteria.

He was able in 1884 to observe and give illustrative drawings of a demonstrative case of the activity of the phagocytes in the blood of a transparent fresh-water flea (Daphnia) when it was infected by a yeast-like parasite called Monospora. This parasite frequently makes its way into the blood of the water flea and, multiplying there, often causes death. Metchnikoff watched with his microscope and made careful drawings of the phagocytes as he saw them in the living flea engulfing and digesting the intrusive Monospora. In some cases the phagocytes, in others the Monospora, got the upper hand. Later when I knew him he had a small aquarium dedicated to the cultivation of these demonstrative water fleas and their infective microbe.

Having now determined to give up his zoological and embryological researches in order to devote the rest of his life to the development of his doctrine of "phagocytosis," Metchnikoff accepted the invitation to become director of a new bacteriological laboratory at Odessa, but, finding the conditions there not favourable to his special work, he relinquished the post in 1888 and, having fortunately been cold-shouldered in Berlin, came to Pasteur in Paris, who, thoroughly appreciating the value of his work, gave him a laboratory and every facility for his investigations in his own institute, at that time located in the Ecole Normale, rue Vaugirard. When a few years later the Institut Pasteur was built in the rue Dutot Metchnikoff was given a fine suite of laboratories, lecture-room, and space for keeping animals, and became sub-director of the institute a few years ago.

Young investigators now came in growing numbers to Paris in order to work in Metchnikoff's laboratory, and he pursued with triumphant success, but not without opposition and sometimes insult from the older and more ignorant medical men, the establishment of his views as to the essential importance of "phagocytosis" in resistance to disease. Among his more fatuous opponents was a prominent English pathologist who scornfully alluded to his views as "Metchnikoffism."

In 1892 he produced as an illustrated volume, with the title "The Comparative Pathology of Inflammation," the substance of a course of lectures delivered at the Institut Pasteur. It is one of the most delightful examples of scientific method conceivable. It is essentially a careful and logical presentation of minute observations arranged so as to bring before the reader the evidence in favour of his argument. He invariably followed this method in the controversies in which he necessarily engaged. He never recriminated; he never cited mere authority nor endeavoured to falsify his opponent's statements by "smart" word-play. He simply made new experiments and observations suggested by his adversary's line of attack, and so practically smothered him by the weight of honest, straightforward demonstration of fact. He showed that in the lower animals the phagocytes are attracted in hundreds by "chemiotaxis" to intrusive or injurious bodies which occur in the tissues, and then either enclose or digest them. He proceeded to show that in the vertebrates, where the immense network of the blood-vessels is under the control of the nervous system, "inflammation" is set up as a curative process, and that the elaboration of its mechanism has been established by natural selection. A local arrest of the blood-stream is produced by the nerve-control of the vascular system, resulting in the out-wandering from the now nearly stagnant blood of phagocytes chemically attracted to an injured spot, where, arriving like an innumerable crowd or army of scavengers, they proceed to engulf and digest tissue which has been killed by injury, and similarly to isolate or to destroy and digest injurious intrusive substances, prominent among which are infective poisonous bacteria.

Metchnikoff thus finally and conclusively "explained" the process called "inflammation." His attention and that of his pupils was now given for some years to the great question of "immunity." How is it that some individuals are either free from the attacks of parasitic micro-organisms to which their fellows are liable, or, if attacked, suffer less seriously than others do? To answer this question is to go a long way to the solution of the great practical question as to how to produce immunity to infective disease in man. It involved the investigation of the chemical activities of the phagocytes, to the knowledge and theoretical understanding of which a great number of highly gifted leaders of experimental inquiry—to name only Ehrlich, Behring, and Almroth Wright—have contributed in the most important way. It is impossible on this occasion to enumerate or even indicate the large series of investigations and records of experiment now continuously produced by Metchnikoff or by assistants under his immediate supervision. The *Annales de l'Institut Pasteur* are largely made up of these records and discussions. In 1901 Metchnikoff produced his great book on "Immunity in Infectious Diseases," an English translation of which was at once published. The subject branched out into various lines, such as are indicated by the names serotherapy, toxins and anti-toxins, hæmolysis, opso-

nins, and bacteriotropins. It must suffice here to state that Metchnikoff successfully established the doctrine that it is to the healthy activity of our phagocytes that we have to look not only for temporary protection, but for immunity against the micro-organisms of disease.

Since 1901—until he fell ill last winter—Metchnikoff was incessantly active in his laboratory, working there from early morning until evening, when he took train to his country house on the heights above the Seine. Rarely would he tear himself away from his absorbing work to enjoy a holiday. He went a few years ago to Astrachan, on the Caspian, to inquire for the Russian Government into the occurrence of bubonic plague in that region, and studied also the incidence of tuberculosis in the town populations and among the Kalmuck Tartars. On the latter subject he gave (in response to my urgent request) a valuable lecture in London before the National Health Society (in 1912), and on other occasions he made short visits to this country in order to receive honours and deliver special discourses—as at the Darwin celebration at Cambridge in 1909. The variety of infective diseases to the experimental investigation of which he turned the resources of his laboratory and his theoretical conceptions is truly astonishing. As late as 1911 he wrote: "Perhaps before long it will be possible to explain diabetes, gout, and rheumatism by the injurious activity of some variety of microbe" (preface to the invaluable volume, "Microbes and Toxins," by Dr. Etienne Burnet, published in London by Heinemann).

In 1903 he found time to write a profoundly interesting popular book, "The Nature of Man" (London: Heinemann), in which, among other things, he discourses of old age, and his view that unhealthy fermentation commonly occurring in the large intestine produces poisons which are absorbed, and lead to deterioration of the tissues of the walls of the arteries, and so to senile changes and unduly early death. He satisfied himself, experimentally and clinically, that the use of "sour milk" as an article of diet checks or altogether arrests this unhealthy fermentation in the intestine by planting there the lactic bacillus which, forming lactic acid, renders the life and growth of the bacteria of those special poisonous fermentations (which cannot flourish in an acid environment) impossible. Hence he himself daily took a pint or so of sour milk, and he recommended it to others and arranged for the commercial preparation of a particularly pure and agreeable "sour milk," from the sale of which he scrupulously abstained from deriving any pecuniary profit. This small, though valuable, adventure of his in dietetics has been—unfortunately, but perhaps inevitably—the one and only feature of his long career of vast scientific discovery which has impressed itself on the somewhat erratic intelligence of the "man in the street."

Metchnikoff was a foreign member and Copley medallist of the Royal Society, a member of the Institute of France, of the Academy of Sciences of Petrograd, and of many other societies. In 1908 he was awarded the Nobel prize for his researches on immunity, and he received only a fortnight before his death the announcement that the Albert Medal of the Society of Arts of London had been this year awarded to him in view of the benefit to humanity of his scientific discoveries.

I cannot close this imperfect survey of the impressive and ideally complete career of my friend without some few personal notes. From the day when I met him in Pasteur's laboratory in 1888 we became warm friends. He was singularly simple, genuine, and unaffectedly good and unselfish. I could tell a hundred tales of his benevolence and humane spirit; of the unrecorded charitable aid given by him and his wife to the poor of Paris and to expatriated Russians; of his exquisite politeness and consideration to all those who were his servants. I am convinced that the devotion of the latter half of his life to the solution of the problems of disease was due to his goodness of heart and his ardent desire to alleviate human suffering. He never was a smoker, and twenty years ago gave up the use of alcohol entirely. He had no taste for sport of any kind, and never indulged in "recreations" or "amusements" or big social functions. He was a devoted lover of music, and had much knowledge of art and many friends in the great art world of Paris. His beard was large and his hair long, and he was thick-set and muscularly strong, though he became more and more bent, as the years went on, by his constant stooping over the microscope. No year passed, after I first knew him, without my spending some time with him and Madame Metchnikoff in Paris or in their home at Sèvres, and on several occasions he has stayed with me in London or earlier in Oxford. From time to time he has shown to me the experiments and microscopic evidence upon which his own and his pupils' discoveries were based, and has put before me the preliminary hypotheses by aid of which he was seeking—as opportunity offered—to arrive at further knowledge of appendicitis, syphilis, the yaws, infantile paralysis, green diarrhœa, cholera, tubercle, cancer, diabetes, gout, and rheumatism. Only three years ago he carried out some new researches on a zoological subject—the natural removal of black pigment from the wing-feathers of gulls—which he proposed to publish in the *Quarterly Journal of Microscopical Science*. But the terrible events of the last two years put such work out of his power. In his last moments he insisted very urgently that an immediate autopsy should follow his death. He had suffered for six months from pneumonia, pleurisy, and latterly bronchitis. The autopsy showed atheroma of the aorta and related cardiac disease. Metchnikoff died in the apartments of the Institut which had been assigned as a dwelling to Pasteur. According to his wish, his remains have been incinerated, and the urn containing his ashes will be placed in the library of the Pasteur Institute.

E. RAY LANKESTER.

SIR VICTOR HORSLEY, F.R.S.

SIR VICTOR A. H. HORSLEY, whose death on July 16 we record with the deepest regret, was born in 1857 of a family long distinguished for ability in natural science and the arts. His descent was chosen by Galton to illustrate the view that unusual talents are hereditary in certain stocks of the community in this island.

On leaving school he entered University College, and carried all before him. He early showed his interest in the physiology of the nervous system, and in 1884 published a study, with Prof. Schäfer, on the functions of the marginal convolution. The same year, at the early age of twenty-seven, he was appointed professor-superintendent of the Brown Institution, a post much coveted by physiologists. His energy and enthusiasm, coupled with his astonishing youth, were a revelation to all who came into contact with him. In his company work became a fascinating game, and never was there such a keen playmate. He was singularly attractive, with a charming voice and infectious laugh; his manner was boyishly unaffected, and as he struck out one line after another in the application of physiology to medicine our enthusiasm was unbounded. He was always sincerely interested in the work of others, and would devote much time and energy to understanding it thoroughly. Throughout his period at the Brown Institution he worked more particularly at hydrophobia, and the functions of the thyroid and pituitary body, besides continuing his studies in cerebral localisation.

Horsley was surgeon to University College Hospital and to the National Hospital for the Paralysed and Epileptic, Queen Square, W.C., and it was at this time that he became the pioneer of surgery of the central nervous system. Instigated by Dr. Hughlings Jackson and Sir William Gowers, he was the first successfully to operate on the brain and to remove a tumour pressing on the spinal cord. To us his operating was an inspiration; he was never at a loss, and his brilliancy lay rather in his attitude to the problem in front of him than in pure mechanical dexterity. He was never afraid, and the complete reliance he placed on his subordinates was sometimes almost embarrassing.

Honours poured upon him. He was early elected a Fellow of the Royal Society, and obtained the Royal medal; Halle made him an M.D., Paris elected him a Fellow of the Académie de Médecine, and numerous medical societies all over the world claimed him as an honorary member. No British worker in his field has been so much admired on the Continent as Horsley.

Practice came to him abundantly, but until shortly before the war he always devoted one day in the week to work in his private laboratory, tucked away under the lecture theatre at University College. Here he did all his work on the functions of the brain, including the long series of researches with Dr. R. H. Clarke on the cerebellum, carried out with an accuracy never before attainable. Many younger men who are now distinguished as neurologists in different parts of the world came to work with him here in London, and owe the success of their researches not only to his guidance, but to his remarkable operative skill on animals, for in almost all cases the actual experimental lesions were his handiwork.

He was Croonian lecturer to the Royal Society, and on this occasion published the work carried out with his brother-in-law, Prof. Gotch, on electrical changes in the spinal cord.

He was, however, essentially a pioneer, interested mainly in working at a subject until the field was laid open to all. This accounts for the comparatively small bulk of his publications. He showed all the surgeons of the world how to operate on the brain and spinal cord, but left no co-ordinated account of his methods, procedure, or results. This was in part due to impatience at being forced to go back over the road he had travelled, and partly to the overwhelming worries of the political and social work into which he threw himself with all his original scientific ardour.

His death was characteristic of his desire always to be moving forwards, to be in the advance, for, as consulting surgeon and inspector of hospitals, he might have stopped in the Mediterranean, where he had been occupied usefully for some time. But he demanded to be sent to Mesopotamia, where he knew the need was urgent, and there he died at Amara, laying down his life at the early age of fifty-nine. H. H.

NOTES.

THE death of Sir William Ramsay on July 23 has deprived the world of one of its greatest men and science of a pioneer whose work has opened up the richest fields of research explored in modern times. For several months the sympathies of scientific men have been with Sir William on his bed of affliction, and rebellious thoughts have surged through the minds of all of us that such an intellectual giant should have been rendered helpless when his dominating influence was most needed in national life. Though he was sixty-three years of age, he was much younger in spirit and vigour; and until last November everyone who knew him supposed that he had a long period of activity still in front of him. He has now passed to his rest, and no words can express the grief felt by his countless friends and admirers at the loss sustained by them and by the nation. His genius was undoubted, and in personal characteristics, as well as in productive work, he represented science at its highest and best. His funeral is taking place at Hazlemere Church, High Wycombe, as we go to press, but the place where his remains should rest is Westminster Abbey, for the honour which he brought to his country would have been justly recognised by this mark of national recognition. The greatness of his work, and the high regard in which it is held, were shown in an article on Sir William Ramsay in our series of "Scientific Worthies" in NATURE of January 11, 1912. His memory will be cherished with affection by all who came under the influence of his attractive personality, and his contributions to knowledge will constitute a permanent monument to him in the fields of science. The nation itself has been exalted by his achievements, and a memorial of them should be placed where all may see and be uplifted by the spirit of scientific life so fully manifested in him.

An instructive example of the manner in which Germany has in the past been permitted to exploit British resources is provided by the management by a German company of the Travancore monazite deposits. The sand was obtained in Travancore at a cost of about 4*l.* per ton, and shipped to Germany for the use of the manufacturers of Germany. Only a limited quantity of the sand was allowed to be sold in the United Kingdom, and the price of about 36*l.* per ton was demanded. In a paper on the British rare-earth industry, read by Mr. S. J. Johnstone at the annual meeting of the Society of Chemical Industry, these and other interesting particulars were given. Prof. Wyndham Dunstan, director of the Imperial Institute, dealt with the same subject in a paper read to the Indian Section of the Royal Society of Arts on June 1, and printed in the issues of the society's journal of July 7 and 14. Thorium, the constituent of monazite of industrial importance, is essential to the gas-mantle industry, which until lately was under German control. Germany, having secured the monopoly of the Brazilian supplies of monazite, was able to dominate the manufacture of gas mantles in this country. Owing to the activities of the Imperial Institute, Ceylon was found to supply scattered monazite and thorianite, the richest known ore of thorium, containing more than 80 per cent. of thoria, as against about 5 per cent. in Brazilian monazite. In 1909 monazite sand was discovered on the coast of Travancore, and the monazite found to contain nearly twice as much thoria as the monazite of Brazil. Thorianite has been secured by the Imperial Institute for British users, by whom virtually the entire output of Ceylon has been taken. Though at first Travancore monazite was worked in German interests, a reconstruction since the war of the company working it will secure its produce also for British industry.

As was the case last year, the Swedish Government has decided to postpone, this time until July 1, 1917, the distribution of the Nobel prizes in physics, chemistry, medicine, and literature.

The Finsbury Technical College Old Students' Association is preparing a scheme to perpetuate the memory of the late Prof. Silvanus P. Thompson in a suitable manner. All who wish to assist in the establishment of such a memorial should communicate with Mr. J. E. Raworth, Queen Anne's Chambers, 28 Broadway, Westminster, London, S.W.

The death is announced, at the age of seventy-eight, of Dr. Bushell Anningson, lecturer in medical jurisprudence in the University of Cambridge since 1884. Dr. Anningson was the author of "Evolution of Human Communities in Relation to Disease," "The Origin and Progress of Sanitary Endeavour," and other works.

Lieut. J. J. Ball, who was killed at the front on June 27 while acting as observing officer, entered the University of London, University College, as a student of civil engineering in 1912, and had just completed his second year's course at the outbreak of the war. He was by no means a "bookworm," but perhaps his distinguishing feature as a student was the quiet determination with which he tackled his studies, even when they were clearly distasteful. His friends and teachers at University College feel that by his death the war has robbed them of a promising young engineer, as well as of a man they were glad to call friend.

Major (Temporary Lieut.-Col.) Boyd Robert Horsbrugh, who died recently at his home, Oxted, Surrey, was well known as an authority on the birds of South Africa, where he had lived for nearly seven years, and had travelled extensively throughout the country; he also served with distinction in the South African war. He is best known as the author of a book on the "Game Birds and Waterfowl of South Africa," published in 1912, a most useful work to the naturalist, but mainly designed to meet the requirements of the average sportsman in that country. A special feature of the work is the field notes by the author and artist, and the beautiful series of coloured plates by Sergt. C. G. Davies, Cape Mounted Riflemen, which bear evidence of being drawn from life by one who had watched and studied in their native haunts the subjects of his pencil.

The death of Paul Lemetayer in Chile closes a most useful career. Born at Avranches in 1849, he was the pupil and later the collaborator of Paul Issidor. In 1881 he was appointed director of the agricultural station at Santiago, and held a distinguished position in connection with agricultural and analytical chemistry in Chile. As technical adviser to the Government, Lemetayer contributed much to the welfare and progress of Chile. The important nitrate industry, the growth of sugar-beet, and the development of vineyards have been specially encouraged by State grants, but agricultural enterprise has also been stimulated in other directions. The "Quinta Normal d'Agricultura," with which Lemetayer was closely connected, is regarded as the largest and best organised of agricultural schools in South America, and is rivalled by few similar institutions in Europe.

Mr. Edgar Albert Smith, who died on July 22, was born in 1847. His father was Frederick Smith, a well-known entomologist, and assistant-keeper in the zoological department of the British Museum. In 1867 Edgar Smith joined the staff of the museum as an assistant, and took charge of the mollusca; for several years he was largely occupied with the arrangement of the famous "Cuming Collection." Afterwards, when the collections were transferred from Bloomsbury to South Kensington, he was responsible for the arrangement of the shell gallery, which he planned especially for the convenience of the numerous amateur collectors and students of shells who visited the Natural History Museum, and at whose service he freely placed his wide knowledge and experience. In 1895 he was promoted to the rank of assistant-keeper, and in 1903 he received the I.S.O.; he retired in 1913. Mr. Smith was recognised as a high authority in conchology, and he was the author of more than 300 monographic and faunistic works on mollusca, including the important volume on the *Challenger* Lamellibranchs. He had held the office of president of both the Conchological and Malacological Societies, and was a member of the Academy of Natural Sciences of Philadelphia and of the Linnean Society of New South Wales.

Capt. J. M. Charlton, who was killed on July 1, at twenty-five years of age, was an enthusiastic naturalist and amateur taxidermist, and had written and illustrated several short works on ornithology, among them "The Birds of South-East Northumberland." He was in Uppingham School from 1907 to 1910. During his last two years there he was one of the official "observers" of the Ornithological Section of the Natural Science Society, and for his last year he was secretary of the section. He was always very keen on birds, spent all his spare time in observing them, and would travel miles on the off-chance of

seeing anything novel to the district. He had also artistic power, and in 1908 was awarded first prize in the school exhibition for some coloured studies of birds. In the Public Schools Essay Competition of 1910 he was awarded a special bronze medal for his essay on "Observations during a Fortnight's Holiday on the Island of Gigha."

IT is officially announced that in view of the possibility of the failure of the third attempt now being carried out by Sir Ernest Shackleton, in a small vessel, to rescue the twenty-two men of his party left on Elephant Island, South Shetlands, and at his urgent request, the Government has now decided to dispatch a vessel from England as soon as she can be fitted out, no suitable wooden vessel being available in any South American port. The Governor and Company of Adventurers of England Trading into the Hudson's Bay have generously placed their vessel, the *Discovery*, which was specially built for Antarctic exploration, at the disposal of the Admiralty, for as long as she may be required for this service, free of all cost. Lieut.-Commander James Fairweather has been appointed to command the vessel, which is now fitting out at H.M. Dockyard, Devonport. On her completion, if news has not been received of a successful issue of Sir Ernest Shackleton's present attempt to reach Elephant Island, she will then proceed to Elephant Island, embarking Sir Ernest Shackleton on her way.

AT the meeting of the City of London Court of Common Council on Thursday, July 20, it was resolved:—(1) That in view of the great advantages which would accrue to British commerce in foreign markets by the use of the decimal system of coinage and weights and measures, in the opinion of this court it is desirable that steps should be taken to ensure its immediate introduction, so that it may be already in operation at the conclusion of the war; (2) That in view of the fact that England and the Allies are entering into arrangements for concerted action with regard to future trade matters, it would be of immense value if one language could be recognised as the commercial language, and taught in all schools, here and abroad. By so doing, English, French, Russian, Esperanto, or any other language decided on would form the basis of communication on business matters throughout the world.

AT the beginning of July a party of thirty men, led by Mr. Birger Johnsson, left Sweden for Spitsbergen in order to work the coal deposits at the head of Bell Sound (Braganza Creek) and Isfjord. At Braganza Creek the coal, though of Tertiary age, is said to be of good burning quality, and there is an average thickness of 2·15 metres over an area of about 100 kilometres. At the Pyramid Hill and in Bünsow's Land, at the head of Isfjord, on the other hand, the coal is culm of Carboniferous age, and is not so good as at Braganza. None the less, these two areas are calculated to yield about 3000 million tons of good coal. Other members of the expedition are Mr. S. Öhman, who will be responsible for the mapping; Mr. H. Odelberg, agronomist, who will see to the provisioning; Mr. E. Lundström, who will serve as botanist and make a map according to Prof. De Geer's photographic method; and a palæontologist, Mr. Erik Andersson, of Upsala, who was recently studying the fossil fishes of Spitsbergen in the British Museum. Mr. Lundström is taking some plants to see if they will grow there. Among them are various willows, the dwarf birch, *Convolvulus sepium*, *Potentilla fruticosa*, and *Papaver nudicaule*.

OF great interest to zoologists is the proposal, reported in the June number of the *Bul. Imp. Acad. Sci.*, Petrograd, to establish a biological station on Lake Baikal. The largest of the fresh-water lakes of Europe and Asia, and said to be the deepest in the world, it possesses a fauna in many respects unique. Some of its fishes are found nowhere else, and some live at a greater depth than any other fresh-water fishes. Among them are very ancient forms, and, according to some investigators, vestiges of the Upper Tertiary and sub-tropical fauna of Siberia and, possibly, of Central Asia. Though Lake Baikal has long since attracted the attention of Russian zoologists, much remains to be done, and it is felt that private research, valuable as its achievements have been, should be supplemented by a fully equipped biological station, which alone can cope with the problems involved in a thorough and systematic investigation. The subject has been mooted for some time past in Russian scientific circles and is now brought within measurable distance of realisation by a donation of 1600*l.* received from a Siberian gentleman, Mr. A. Vtorov, and the Academy has appointed a commission to take immediate steps to give concrete form to a project destined to be of great importance for biological science.

IN the July issue of *Man* Mr. J. Reid Moir publishes a further report on the discovery of human bones and other articles of Neolithic and later date in the Ipswich district. The skeleton of an individual buried in the contracted posture has been examined by Prof. Arthur Keith, who reports that it is that of a lad of the Neolithic age, decidedly smaller and of slighter make than a modern boy. Of another skull Prof. Keith remarks that "amongst British skulls, attributed to a prehistoric or pre-Roman date, a markedly prominent nose is very rare: I have never seen a single case." As regards the stature and muscular development of some of these skeletons, it is to be regretted that, although the skeleton was represented in each case, the long bones were so fragile and fragmentary that it was found impossible to obtain complete reconstruction.

WE have received from the National Clean Milk Society copies of two publications just issued by the society. One is a leaflet intended for distribution among producers of milk, containing recommendations for the care of cows and of milk which should be observed by farmers and dairymen. These are simple and capable of being carried out by all, and if observed would do much to ensure a clean milk supply. The other publication is a form of agreement for the wholesale purchase and sale of milk by institutions, dealers, and milk producers. In particular it provides for the tuberculin testing of all cows and for a bacterial content of the milk not exceeding 60,000 bacteria per cubic centimetre. This last provision is certainly a very stringent one, and difficult to attain; unless the conditions of bacteriological examination are very carefully defined it will lead to trouble, for American investigations have recently shown an extraordinary variation in the bacterial content of the same milk sample examined by different observers. The agreement is, however, for a high-grade milk, the price of which is put at 2*d.* per gallon more than that of ordinary or market milk.

THE need of a publication in English which will contain not only abstracts of purely physiological papers, but also summaries of important papers bearing on physiology in other branches of science, has long been recognised. It is hoped that the *Physiological Abstracts* will meet this need, and will also

form a link between British and American physiologists and their colleagues in France, Russia, Italy, Scandinavia, and Holland. The abstracts are issued by the Physiological Society of Great Britain and Ireland, under the able editorship of Prof. W. D. Halliburton, and with the co-operation of the American Physiological Society; associated with the editor are many of the most eminent physiologists in this and other countries. The publication is issued monthly, and although, up to the present, only four numbers have appeared, there is no doubt as to its value for purely physiological workers. Indeed, its success appears to be assured, not merely from a scientific point of view, but also as regards its wider purpose of more closely uniting physiologists in the allied and neutral countries.

MENTION has already been made in these columns of the very useful and comprehensive survey of the phenomena of light production by animals which Mr. Ulric Dahlgren is publishing in the Journal of the Franklin Institute of Pennsylvania. In the May and June numbers he proceeds with his task, surveying now the marine worms and the crustacea. The author makes no claim to originality in regard to this work, but he has added materially to our knowledge of the histological structure of these light-producing tissues. Particular attention is directed to the difficulty of finding any satisfactory interpretation as to the significance of the extraordinary luminosity of Chætopterus, one of the most luminous of living animals, but which, like the mollusc Pholas, endowed with like powers, lives in a burrow on the sea-floor. In some of the crustacea a luminous discharge is made which seems to serve, like the ink of the cuttle-fish, as a means of escape from enemies.

THAT the maple aphis (*Chaitophorus aceris*) gives rise to dimorphic larvæ, the one normal, the other having a tessellated carapace, and the abdomen, anterior border of the head, and the limbs fringed with small leaf-like expansions, has long been known. When first discovered, however, this curiously modified type was regarded as representing a distinct species. In the Proceedings of the South London Entomological and Natural History Society, 1915–16, Mr. E. J. Bunnett reviews the work of earlier observers, and adds some valuable observations of his own, based on specimens bred from two black apterous females during June, 1914. In the course of his investigations he was further enabled to show that this "pseudomorphic," or periphyllous, form is produced also by the winged black form. An admirable figure of this most puzzling larva compared with the normal form adds immensely to the value of this contribution.

No. 3 of vol. iii., series ii., Fishery Investigations, Board of Agriculture and Fisheries, has just been published. It is an analysis and review of the English plaice-marking experiments carried out in the North Sea since 1903. In the course of this work more than 17,000 living plaice were marked and liberated. The objects of the investigation were mainly the detection of migrations and of their causes, an estimate of the rate of growth of the fish in different seasons and areas, and an estimate of the actual effect of fishing upon the North Sea plaice population. In spite of the large mass of material dealt with, it has not been possible to attain to very definite conclusions with regard to these questions. The movements of plaice in the North Sea are rather of the nature of general dispersions than of movements along definite paths, correlated with seasonal conditions. Growth, too, is remarkably variable. An important and interesting result apparent from the experiments is the practicability of carrying out "transplantation" on a very large scale with valuable commercial results. In such areas as that of the Dogger Bank growth is much more rapid than in the coastal areas, and removal of small fish from the latter to the former grounds would be an economically valuable proceeding if possible on an international scale.

IN the *National Geographic Magazine* for May Mr. Hiram Bingham, director of the expedition sent to Peru in 1915 by the National Geographic Society and Yale University, gives an account of the operations. Its main object was to secure information about the inhabitants of the wonderful city of Machu Picchu, which was discovered during the exploration of 1911. Several ancient Inca trails leading to the city were examined, and it was ascertained that Machu Picchu was the centre of a densely populated region, the inhabitants of which possessed a highly organised civilisation. Amongst other discoveries, a considerable number of trepanned skulls were found. It is remarkable that a people capable of constructing these fine megalithic buildings, and whose skill in engineering, pottery, and textiles was of a high order, should not have succeeded in inventing an alphabet or even some form of hieroglyphic writing similar to that which existed in Mexico and Central America. The report is illustrated by an excellent collection of photographs.

WE have received the report of the Survey of India for 1914-15, which shows considerable progress despite the shortage of staff. Of the 1-in. map 154 sheets were published during the year, of the "degree" sheets seven, and of the "one-millionth" map five sheets. A preliminary edition of the map of Tibet, on a scale of 1 to 2,000,000, has been published. The Government of India has sanctioned the publication of a new "half-inch" map of India, which is to be compiled from available sources. One sheet has, so far, appeared, but several new sheets should be ready shortly. In addition to this work, a great deal of topographical survey was done during the year. Quicker progress in survey work can be expected in future years, as it has been decided to reduce the scale for certain sparsely populated areas. About half of the 600,000 square miles that remain are to be surveyed for a half-inch or smaller scale.

COMMUNICATIONS No. 147 and 148 from the University of Leyden contain new data obtained by Prof. Onnes and his pupils with regard to the behaviour of oxygen, nitrogen, neon, and helium at low temperatures. For helium the vapour pressure varies with absolute temperature as follows:—At $1{\cdot}48^\circ$ $p=0{\cdot}42$; $3{\cdot}52^\circ$, 36; $4{\cdot}20^\circ$, $75{\cdot}8$; $4{\cdot}9^\circ$, 133; $5{\cdot}16^\circ$, 167 cm. of mercury. For neon the isothermals at 20° C., 0°, -183°, -200°, -208°, -213°, and $-217{\cdot}5^\circ$ are given, and liquid neon is shown to provide a much-needed constant temperature bath in the gap between 55° absolute, which is furnished by liquid oxygen, and 20° absolute, for which liquid hydrogen is available. The behaviour of neon corresponds closely with that of argon. The previous vapour pressure tables of oxygen and nitrogen are corrected according to the most recent comparisons of the platinum with the hydrogen thermometer, and for oxygen vapour pressures are given from $90{\cdot}2^\circ$ absolute when the pressure is $76{\cdot}7$ cm., down to $57{\cdot}4^\circ$ when it is $0{\cdot}27$ cm. For nitrogen vapour pressures are given from $80{\cdot}5^\circ$ when $p=108{\cdot}6$, down to 57°, at which it is $2{\cdot}2$ cm. of mercury.

MR. A. B. DOBROWOLSKI has recently contributed to the *Arkiv för Kemi, Mineralogi och Geologi* (vol vi.

No. 7, pp. 1–53), under the title "Les cristaux de glace," an interesting *résumé* of what is as yet known of this the commonest of substances, in which he points out the lacunæ that remain and the questions that are still unsettled. He has himself studied no fewer than 3000 photomicrographs of actual ice crystals under the microscope, the photographs being taken from the fine collections formed by A. W. Bentley, G. Nordenskiöld, and F. Hallberg. There appear to be three different types of habit of natural crystals of ice, viz. lamellar, rod-like, and acicular, of which the first is by far the commonest. The author hazards the suggestion that the other two result from the transitory presence in the air of certain unstable gases, but hesitates to say which. From a study of the tapering, rod-like crystals he concludes that ice belongs to the tourmaline class of the hexagonal system, which is characterised by a trigonal polar axis of symmetry. No measurements which will permit of the determination of a satisfactory value for the ratio of the crystallographical axes have yet been published; that quoted in the text-books is based upon some extremely rough observations made by Nordenskiöld, and is quite untrustworthy. In the rod-like and acicular types twinning about 0001 is common, as is shown by the existence of groups in which two tapering ends are aligned in contact. It is well known that laboratory experiments have produced different kinds of crystals of ice. For instance, water when containing more than 50 per cent. of alcohol forms cubic crystals on freezing. For a smaller percentage such crystals, if formed, are unstable, and their occurrence in Nature would therefore appear doubtful. Certain photomicrographs taken by Bentley and by Hallberg appear to suggest cubic symmetry, but, failing optical tests, it remains uncertain whether they may not be merely distorted forms of the ordinary type of crystals.

THE following volumes are announced for early publication in the "University of Chicago Science Series" by the University of Chicago Press (London: Cambridge University Press):—"The Origin of the Earth," T. C. Chamberlin; "The Isolation and Measurement of the Electron," Prof. R. A. Millikan; and "Finite Collineation Groups," Prof. H. F. Blichfeldt. Other volumes in preparation for the same series are:—"The Evolution of Reptiles," S. W. Williston; "Food Poisoning," E. O. Jordan; "The Problem of Individuality in Organisms," C. M. Child; "The Development of a New System of Organic Chemistry, based on Dissociation Concepts," J. U. Nef and J. W. E. Glattfeld; "The Living Cycads," C. J. Chamberlain; "Mechanics of Delayed Germination in Seeds," W. Crocker; "The Rigidity of the Earth and of Materials," A. A. Michelson; "The Problem of Fertilization," F. R. Lillie; and "Linear Integral Equations in General Analysis," E. H. Moore.

MESSRS. CONSTABLE AND CO., LTD., announce the following books of science:—"The Flying Machine from an Engineering Standpoint," F. W. Lanchester (the James Forrest Lecture, 1914, including a discussion concerning the Theory of Sustentation and the Expenditure of Power in Flight); "Some Modern Methods of Ventilation, with Special Reference to Public Buildings," R. Grierson, illustrated; "Mining and Mine Ventilation," J. J. Walsh, illustrated; "Practical Surveying," E. McCullough, illustrated; "Colour and its Applications," M. Luckiesh, illustrated; "Atoms," J. Perrin, translated by D. L. Hammick, illustrated; and a new and enlarged edition of "Manual of Reinforced Concrete," C. F. Marsh and W. Dunn.

OUR ASTRONOMICAL COLUMN.

PONS-WINNECKE'S COMET AND THE METEORIC SHOWER OF JUNE 28.—Mr. Denning writes:—"That the remarkable display of June 28 was due to the earth passing through or very near a cometary orbit appears highly probable. The elements of the meteoric shower present some resemblances to those of Pons-Winnecke's comet of 1819, which has a period of about 5·8 years, and last reached perihelion on September 1, 1915. Any meteoric shower connected with Pons-Winnecke's comet, though not visible in past years, may well be perceptible in future times. In 1869 the perihelion distance was 0·7815, or about 21½ millions of miles inside the earth's orbit, but in 1915 the P.D. had increased to 0·9725, or only 4 millions of miles inside our orbit. Planetary perturbations have effected changes in the orbital elements of the comet, and brought it so near to us at one section that a meteoric *rencontre* seems very likely."

DIFFERENTIAL MEASUREMENT.—Mr. H. H. Plaskett has made an interesting study of some questions involved in measures of the distance between a pair of lines with the object of tracing the origin of differences found when different observers measure the same spectrograms, with special reference to spectrographic determinations of the solar rotation (Journal Roy. Ast. Soc. of Can., vol. x., No. 5). He finds the chief source of these differences is the "attitude" of the observer, and defines two modes of measurement, the "attentive" and the "automatic," according as the measures are made under the influence of prepossessions or otherwise. It must suffice to add that the automatic mode is found to possess the desirable advantages of speed, accuracy, and economy of effort, but is marred by high fortuitous error (apparently, greater p.e.). Mr. Plaskett is of the opinion that the highest accuracy can only be attained in replacing differential measures by determinations of changes of wave-length with the help of standard absorption lines. A very successful application of these results has already been made at Ottawa (NATURE, May 18).

WAVE-LENGTHS IN THE IRON SPECTRUM.—Interferometer measures of the wave-lengths of some 400 lines in the spectrum of the iron arc in the region covered by the international secondary standards have been made by Messrs. Burns, Meggers, and Merrill in continuation of the revision of wave-lengths undertaken at the United States Bureau of Standards (Scientific Paper No. 274). The poles used were either of electrolytic or Norwegian iron, and only iron lines were measured. The reductions were based on the international secondary standards, and the final wave-lengths were corrected by means of a smoothed curve obtained by plotting the differences between observed and normal wave-lengths of the standard lines. The mean difference is stated to be about one part in four millions. Three interferometers have been used in measuring each line, and, in addition to the work on wave-lengths, considerable attention has been devoted to observations of the physical characteristics of the lines. Thus, more than five hundred lines have been divided into four groups according to the limiting path difference at which interference is shown, and the data have been examined in connection with pole-effect, intensity, and pressure shifts. It appears that lines showing negative pole shift are never sharp; lines of faint or moderate intensity are sharper than strong lines, whilst the lines shifted by pressure are more likely to be broad than unaffected lines.

SOUTHERN GEORGIA AND ITS HYDROGRAPHY.[1]

Along the eastern coast of North America, commencing at Long Island and passing southward through Virginia, North and South Carolina, Georgia, and Florida, there lies a broad tract of country known as the Atlantic Coastal Plain. This plain, which also extends round the northern part of the Gulf of Mexico, where it is distinguished as the Gulf Coastal Plain, is a region of low elevation, with a relatively gentle seaward slope. Part of it passes through and embraces 35,000 square miles of the southern half of the State of Georgia, and this constitutes the purview of an extremely interesting and informative report issued by the United States Geological Survey, from which the following particulars are gleaned.

Although characterised as a plain in comparison with the mountainous country behind, the expanse under consideration is not entirely without topographical features and contrasts. There are hilly and broken areas, especially towards the north, but these do not rise above the general level, and their summits present an even skyline. The plain lends itself to subdivision into six physiographical districts, the nature of which may be to a large extent gauged from their designations, viz., the Fall-Line Hills, the Dougherty Plain, the Altamaha Upland, the Southern Lime-Sink Region, the Okefenokee Plain, and the Satilla Coastal Lowland. The lithological components of these belts are principally sands, clays, and marls, with, subordinately, limestones and sandstones. The former are largely unconsolidated, and have undergone little alteration since their original deposition. The sediments are representative of the Lower Cretaceous and subsequent systems, and include the Ripley Formation, about 950 ft. thick, of grey, calcareous, and micaceous sand, and sandy clay, and the Midway Formation, about 400 ft. thick, of ferruginous sand, with local beds of white clay, and fossiliferous limestone and calcareous quartzite. The Cretaceous deposits immediately and unconformably overlie a basement of crystalline rocks believed to be pre-Cambrian.

The mean annual rainfall of the plain is about 49 in., and the quantity absorbed by the soil and rocks is roughly estimated at 90 to 95 per cent. of the total. If nearly 60 per cent. of the rainfall be assumed to be lost by evaporation and 4 or 5 per cent. escape as run-off or flood-flow, there remains about 35 per cent. to form the underground water supply; but much of this is not actually utilisable, on account of the depth to which it descends.

Although several of the cities in central Georgia, such as Augusta and Macon, obtain their water supplies from adjacent rivers, the majority of the inhabitants have to depend upon supplies drawn from artesian wells, of which there are probably some 700 or 800 in active operation. These wells range in depth from 100 to 1000 ft. All the Cretaceous formations contain water-bearing strata, as also the Eocene and Oligocene series of the Tertiary system. The Quaternary system furnishes non-artesian water, which is tapped by shallow borings. Such water, on account of its high content of organic matter in many cases, is not generally suitable for domestic use.

A large number of analyses of the ground waters have been made, and from them it is computed that relatively few contain normal carbonate (CO_3), while the presence of hydrogen-sulphide gas and of excessive amounts of iron is reported in waters from all the formations. The gas imparts an objectionable odour in certain instances and gives rise to corrosion in boilers and mains. The iron, which in a number of cases exceeds three parts per million, is then perceptible to the taste, and tends to produce stains in fabrics which are washed in it.

B. C.

[1] "Underground Waters of the Coastal Plain of Georgia." By L. W. Stephenson, J. O. Veatch, and R. B. Dole. (Water Supply Paper No. 341.) Pp. 539, with photographs, maps, and diagrams. Washington: United States Geological Survey, 1915.)

HARDNESS AND CRITICAL COOLING VELOCITIES OF STEELS.

The maximum cutting hardness of pure carbon tool steel is achieved by water-quenching. With the introduction of Mushet's special steel, engineers obtained a material which was called "self-hardening," because it did not require to be water-quenched in order to bring out its maximum cutting hardness. It was sufficient for the tool to be cooled from above a certain critical temperature in air. The modern high-speed tool steel falls into the same class of materials, the chief difference from Mushet's special steel being that the "lip" or "nose" of the tool requires to be actually melted and then cooled in an air blast if the maximum cutting hardness is to be obtained. Stated in general terms, therefore, the rapid-cutting tool of to-day is gas-quenched as contrasted with the carbon tool, which is water-quenched.

Various theories of the mechanism of the above changes are held, and therefore the research by Prof. C. A. Edwards, of the University of Manchester, assisted by J. N. Greenwood and H. Kikkawa, recently presented to the Iron and Steel Institute, on some very remarkable properties of a chromium steel, is to be welcomed in that it throws valuable light on what are to some extent matters of dispute. This steel contained 6·15 per cent. of chromium and 0·63 per cent. of carbon, the balance being iron, except for impurities unavoidably present in small amounts. By suitably varying the initial temperature and the cooling velocity of this steel by air-quenching, Brinell hardness numbers varying from 194 to 700 could be obtained. Such a material therefore falls within the category of self-hardening steels in the sense that water-quenching is not required to harden it. On the other hand, it was found that unless a certain critical velocity of cooling was exceeded depending on the initial temperature this steel did not harden. In this sense, therefore, the steel does not appear to be self-hardening. On this point the authors say:—"Whilst with the chromium steel the cooling rates which produce hardening are extremely slow as compared with those which are obtained in the hardening of steels by quenching, the two operations are fundamentally the same. In other words, a given rate of cooling, which might be regarded as slow for carbon steels, really constitutes quenching in the case of some special alloy steels." The authors have further found that the hardening of the steel coincides with the presence of large quantities of martensite, and a diminution in the magnitude of the carbide thermal change. The maximum hardness was obtained when the thermal transformation had been entirely prevented, and when this was accomplished the steel was purely martensitic in structure. The following table gives the connection between the initial temperature and the cooling velocities between 836° C. and 546° C. which suppress the carbide change:—

Initial temperature °C	Cooling velocities ′ ″
860	1 36
908	2 24
960	3 0
1029	4 0
1147	6 0
1200	7 0
1267	8 56

H. C. H. Carpenter.

THE SOCIETY OF CHEMICAL INDUSTRY.

THE annual general meeting of the Society of Chemical Industry was held in Edinburgh on July 19–21. The meeting this year took the form of a congress on the progress made since the outbreak of war in British chemical industry. The following papers were read and discussed:—

(1) *Fuel.*—Fuel economy: a national policy required, Prof. H. E. Armstrong; Some recent improvements in coke works practice, Dr. G. P. Lishman; Waste in coal production, Prof. H. Louis. (2) *Shale Oil.*—The shale oil industry, D. R. Steuart. (3) *Tar Distilling.*—A short review of the influence exerted by the war on the tar distilling industry, W. H. Coleman; The extraction of tar fog from hot gas, G. T. Purves. (4) *Dyes.*—The difficulties of coal-tar colour-making in war-time, C. M. Whittaker (British Dyes, Ltd.). (5) *Fine Chemicals.*—Notes on the production of alkaloids as affected by the war, D. B. Dott; The manufacture of synthetic organic drugs as affected by the war, F. H. Carr; The manufacture of fine chemicals in relation to British chemical industry, C. A. Hill and T. D. Morson. (6) *Paper-making.*—The paper-mill chemist in war-time, J. F. Briggs. (7) *Patent Law.*—The overhauling of our Patent Law, J. W. Gordon; The influence of the Patent Laws upon industry, W. F. Reid; Proposed amendments to English Patent Law, W. P. Thompson. (8) *Rare Earths.*—The progress of British rare-earth industry during the war, S. J. Johnstone.

To illustrate the progress that has been made, an exhibition was held, at the same time, of specimens of British-made coal-tar dyes, glass, porcelain, and filter paper, along with several other interesting substances now made in Edinburgh. Among these may be mentioned cobalt-blue—a substance never before manufactured in this country—now made by the Beaverhall Colour Co.; trinitrotoluene by the Lothian Chemical Co.; erasers, etc., manufactured by the North British Rubber Co., the supply of which formerly was entirely imported from Germany. The papers, and the discussions upon them, will be printed in the Journal of the Society of Chemical Industry.

TECHNICAL EDUCATION AND INDUSTRY.

AT the annual conference of the Association of Teachers in Technical Institutions on June 24 Dr. W. Garnett read a paper on technical instruction after the war. His arguments and examples, drawn from his long experience of the administration of technical education in London, should convince statesmen and manufacturers of the imperative need for a close *rapprochement* of industry and science. Dr. Garnett thinks that one of the most important effects of the war has been the bringing together of men of science and leaders of industry. Manufacturers have learned more clearly than before that scientific men can help them in the solution of technical problems of industry, and men of science appreciate more fully that the world of manufacture provides problems worthy of their best attention. Urging the necessity for industrial research, he said the greatest need of the teachers in technical institutes is more time and facility for research, and the greatest need of British industry is that more research should be devoted to it. Dr. Garnett also dealt comprehensively with the organisation of technical training, the need for changes in the character of the science teaching in secondary schools, and the part that science should take in Civil Service examinations.

The principal points of the paper are summarised as follows:—

(1) Leaders of industry must place a higher value on industrial scientific research, which is the greatest need of British industry.

(2) Teachers in technical institutions must be more closely associated with industrial leaders.

(3) Time and other necessary facilities must be given to teachers in technical institutions to enable them to carry out industrial research.

(4) Consumers must be willing to make a sacrifice in order to contribute to the nursing of infant industries, so as to avoid entire dependence on foreign sources for the necessaries of life or civilisation.

(5) The war has shown that our universities and technical schools are able to render services to the State which very few persons two years ago believed to be possible.

(6) Trade associations and technical institutions should combine to co-operate with the Advisory Council for Research.

(7) A better connection is required between the elementary school and the technical institute, and this will, in part, have to be supplied by a compulsory continuation school for boys leaving the day school at fourteen, and by extension of the leaving age in central and higher elementary schools.

(8) A more complete organisation of the educational system is required so as to provide suitable training for all ranks of industrial workers, making appropriate distinction between the manual workers and the thinkers.

(9) A more liberal system of scholarships is necessary, especially to enable university students to engage in post-graduate research.

(10) Reasonable prospect of suitable promotion must be offered to students who have passed through a course of training intended to prepare them for higher industrial appointments.

(11) Science should be taught to all the pupils of secondary schools, but the course of instruction for boys in classical forms should differ from that for boys who are intending to pursue the study of science after leaving school.

(12) In Civil Service and other public examinations a general knowledge of physical phenomena and the applications of science to industry should be required of all candidates; but science should not be pitted against the humanities in competitive examinations.

(13) With elementary students practice must almost always be in advance of theory; and theory should not be introduced into elementary teaching until the pupils have been led to recognise its necessity.

(14) Much of the equipment of the schools and some of the methods of instruction will be modified in consequence of experience gained during the war; and it is desirable that all teachers in technical institutions should be prepared for these changes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The University has decided to institute a new course of study in scientific and technical subjects preparatory to military duties, and to accept this course as a part of the intermediate course for degrees in arts, science, law, and commerce. The new course, while counting as a degree subject, will be carried out in conjunction with the work of the Officers Training Corps.

Mr. W. Morrison, to whose personal interest in its library the University is under obligation, has given 1000*l.* for the development of the new School of Russian Studies, of which the Sir James Roberts professorship of Russian language and literature will be the centre.

LONDON.—At a meeting of the Senate held on July 19 offers were accepted with thanks from (1) an anonymous donor to establish an endowment fund producing 200*l.* a year, to be devoted to the prosecution of experimental scientific research at King's College by members of the staff and post-graduate students of the college; (2) Dr. R. W. Seton-Watson to provide 100*l.* a year for five years towards the expenses of the library of the School of Slavonic Studies at King's College; (3) the War Office to present to the University a German aeroplane which had been shot down in France by the Royal Flying Corps.

The following doctorates in science have been conferred:—*Botany*: (1) Mr. W. Brown, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "Studies in the Physiology of Parasitism: I.—The Action of *Botrytis cinerea*"; (2) Mr. Franklin Kidd, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "The Controlling Influence of Carbon Dioxide." *Psychology*: Miss Nellie Carey, an internal student, of University College, for a thesis entitled "Factors in the Mental Processes of School Children." *Engineering*: Mr. F. T. Chapman, an external student, for a thesis entitled "The Air-Gap Field of the Polyphase Induction Motor."

THE directors of British Dyes, Ltd., have promised to contribute 5000*l.* towards the scheme for the erection of a new chemistry department at Huddersfield Technical College for the development of advanced teaching and research in applied chemistry, referred to in NATURE of June 29, p. 373. Half of the contribution is towards the building fund and the remainder for scholarships and research.

THE Executive Committee of the City and Guilds of London Institute has appointed Dr. W. Eccles to the professorship of electrical engineering and applied physics at the institute's Technical College, Finsbury, rendered vacant by the death of Prof. Silvanus P. Thompson. Dr. Eccles is at present university reader of graphics at University College, and is the author of a work on "Wireless Telegraphy and Telephony," and numerous papers and inventions on subjects connected with electrical engineering.

THE issues of *Science* for June 30 and July 7 announce further gifts to higher education in the United States, among which the following are most important. Members of the Du Pont family, who are alumni of the Massachusetts Institute of Technology, have given 160,000*l.* for the extension and maintenance of the new buildings. Four other alumni have subscribed sums amounting to 40,000*l.* It is understood that an anonymous donor who has already made large gifts to the institute has undertaken to give five dollars for each three dollars subscribed by the alumni during the present year. The will of Mrs. Helen C. Julliard gives 10,000*l.* to the American Museum of Natural History, and 5000*l.* to Colorado College. Mrs. Russell Sage has given 15,000*l.* to Knox College of Galesburg, Ill., to make possible the securing of the amount to complete its 100,000*l.* endowment fund.

A COPY of the report of the Secretary of the United States General Education Board for 1914–15 has been received from New York. During the year grants were made to eight American colleges and universities amounting to 255,000*l.* towards funds amounting to 1,040,000*l.*, which were being raised by them. Reference is also made to grants totalling 550,000*l.* in the previous year to Johns Hopkins, Yale, and Washington Universities for the purpose of reorganising clinical instruction on the basis that the hospital and teaching staff in medicine and surgery may devote their entire time to the service of the hospital and medical school, withdrawing altogether from paid private practice. The scheme has not yet been inaugurated at Yale or at Washington; but at the Johns Hopkins University it had at the date of the report been in operation a year. The Board continued during the year under review to support rural schools in eleven southern States, professors of secondary education in eleven, and negro education in seven States. The report also states that the General Education Board has decided, by means of grants, to aid promising workers in the investigation of problems in educational theory and practice.

THE report of the council to the members of the City and Guilds of London Institute for the year 1915 has now been published. The continuance of the war has led to further modifications of the work of the institute. The absence of many members of the staff has thrown much extra work on those left behind, especially upon the heads of departments. The staff and some senior students have undertaken much new and original work in the design and manufacture of munitions of war. The institute's laboratories and workshops are being utilised for war work to their full extent. The roll of honour of past and present students and members of the staff of the City and Guilds College who have taken service in the Navy or Army had on November 10 last a total of 811: 514 commissioned officers and 297 non-commissioned officers and men. As a result of the abnormal conditions the work of the department of technology has suffered; the number of students in attendance at registered classes fell from 55,996 in 1913–14 to 47,050, while the number of candidates for examinations in technology in the United Kingdom was 15,623, as compared with 23,119 in the previous year. The report shows that the total amount of the donations and subscriptions to the funds of the institute since its foundation in 1878 to the year of the report (1915) was 952,773*l.*

THE first volume of the report of the U.S. Commissioner of Education for the year ended June 30, 1915, has been received from Washington. It is a volume of 780 pages, and, in addition to a full treatment of all grades of education in the United States, provides chapters on the condition of education in the chief countries of the world. A chapter on higher education in the States, by Mr. S. P. Capen, is of special interest. He tells us that the conviction that both higher and secondary education must be made more sound and serious has been reiterated in educational gatherings throughout the United States, and has been reflected in numerous intensive studies of college and university administration and standards. The organisation and management of State-supported institutions for higher education have, at the request of various legislatures, been critically investigated with a view to render their work sound and efficient. The question of academic freedom, too, has been widely discussed. Within the past two or three years there have been so many recurrences of disciplinary action directed by trustees and presidents of prominent institutions against professors reputed to hold unorthodox political, economic, or religious views that the question of academic freedom has become temporarily one of the foremost issues in university administration. As Mr. Capen says, upon its correct settlement depends not only the integrity of the universities, but, more remotely, the whole welfare of American education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 29.—Sir J. J. Thomson, president, in the chair.—Prof. A. **Schuster**: The determination of gravity at sea. Dr. Duffield has recently described some preliminary experiments on the measurement of gravity at sea by means of a new method originally suggested by Hecker, and, in the main, consisting in balancing the pressure of a column of gas kept at constant temperature and that of a column of mercury the length of which can be indirectly determined. The results are very promising, but as the ultimate success of the method must depend on the elimination of errors due to unavoidable disturbances, it seemed advisable to discuss the theory of the apparatus a little more fully. The present paper deals more particularly with the effects of the forced oscillation of the mercury due to the vertical motion of the ship, but other sources of error are also considered.—Prof. J. **Joly**: The genesis of pleochroic haloes. Both uranium-radium and thorium haloes develop according to the same laws, certain internal structures appearing first in the form of ring haloes. The addition to these of the outermost feature due to RaC or ThC_2 appears at an early stage. Intermediate details then follow. It is clearly shown that some cause exists to modify the effects of the divergence of the rays outwards. Haloes derived from emanation of radium as primary substance have been identified; also what appear to be "reversed" haloes.—C. T. R. **Wilson**: Some determinations of the sign and magnitude of electric discharges in lightning flashes. Measurements have been made of the sudden changes produced in the potential gradient at a point on the earth's surface by lightning discharges, the approximate distance of the discharge being in many cases determined by timing the resultant thunder. The results of one thunderstorm (August 15, 1915) may be interpreted as indicating that the discharges were nearly all approximately alike, Q being about 33 coulombs and H of the order of 10 kilometres; the range of variation in the distances of the discharges was not quite sufficient to decide whether the discharges reached the earth's surface or not, but the value of Q is practically the same on either view.—S. **Chapman**: The kinetic theory of a composite monatomic gas: diffusion, viscosity, and thermal conduction.—Dr. T. **Goodey**: Further observations on protozoa in relation to soil bacteria. (1) Protozoa, especially amœbæ of the *limax* groups, and other larger forms, can lead an active existence and multiply in soil and exert a depressing effect on bacterial numbers. (2) It is probable that for a given soil a certain point must be reached in protozoal numbers before the depression in bacterial numbers is caused. (3) It appears to be necessary to add the protozoa to a treated soil in a small quantity of untreated soil to ensure their having a suitable medium in which to grow and multiply. Under these conditions it is shown that they can increase in numbers and depress the numbers of bacteria. (4) It does not appear to be possible to carry out mass inoculations of protozoa into a treated soil in such a way that they come into action and limit bacterial activity, and the explanation advanced to account for this failure is that the treated soil affords an unsuitable medium for the active trophic existence of protozoa.—Dr. Marie C. **Stopes**: New Bennettitean cones from the British Cretaceous. The present paper describes two new types of well-preserved fructifications of Bennettites in Britain. One is that of an entirely new species from the Gault; the other is from a Lower Greensand specimen, diagnosed from externals by Carruthers, but not hitherto described.—T. R. **Merton** and J. W. **Nicholson**: Phenomena relating to the spectra of hydrogen and helium. (1) A method has been found for the accurate determination of the photographic intensities of spectrum lines and the reduction of such intensities to absolute values by comparison with the continuous black-body radiation of the carbon arc. (2) A study has been made of the relative intensity distribution in the spectra of helium and hydrogen under different conditions of excitation. (3) It has been found that under certain specified conditions there is a transfer of energy from the longer to the shorter wave-lengths in any given series, and that, under such conditions, the associated series, and in particular the diffuse series, are relatively enhanced at the expense of the principal series. (4) It has also been found that the distribution of intensity found in certain celestial spectra can be approximately reproduced in the laboratory. (5) A study has been made of the separations of the components of lines of the Balmer series of hydrogen, and the mean values of the separations of the doublets constituting the lines $H\alpha$ and $H\beta$ have been found to be respectively 0·132 A.U. and 0·033 A.U. These values are consistent with the separations appropriate to a principal series, and the first is in precise agreement with the value deduced by Buisson and Fabry.—F. P. **White**: The period of a spherical resonator with a circular aperture. In a recent paper in the Proceedings of the Royal Society, Lord Rayleigh has carried the determination of the wave-length of the fundamental aerial vibration in a spherical vessel with a small circular perforation to a higher degree of approximation than was done by Helmholtz. The present communication employs Lord Rayleigh's method to obtain a still closer approximation to the wave-length.—Capt. S. R. **Douglas**: The *rôle* of the blood fluids in the intraleucocytic digestion. Rosenow came to the conclusion that the variation in the degree of digestion undergone by the micro-organisms after their ingestion by the leucocytes was due to a property of the serum which was quite independent of the opsonic power. Further, he concluded that the serum influenced the digestion of the ingested bacteria by acting directly on the leucocytes—not on the bacteria—stimulating them, so that they had greater digestive powers. The experiments, of which details are given in the present communication, confirm Rosenow's results as regards the blood fluids possessing the power of favourably influencing the digestion of bacteria ingested by the leucocytes, and that this property is quite independent of the opsonic power; but, contrary to his conclusions, these experiments definitely prove that the blood fluids act directly on the bacteria or on the red blood cells, preparing them for digestion by the leucocytic ferments. In addition to these conclusions, they show that heating normal serum to 60° C. for a few minutes completely destroys this property.

WASHINGTON, D.C.

National Academy of Sciences, June 15 (Proceedings No. 6, vol. ii.).—W. L. **Hart**: Differential equations and implicit functions in infinitely many variables. Three problems are handled: First, certain fundamental theorems concerning a type of real-valued functions of infinitely many real variables. Second, the problem of infinite systems of ordinary differential equations. Third, the fundamental problem of implicit function theory in this field.—Jacques **Loeb**: The sex of parthenogenetic frogs. Two frogs obtained by artificial parthenogenesis, one ten months old, the other thirteen months old, were found to be males, and the thesis that animals produced by artificial parthenogenesis are males is thus further corroborated.—J. A. **Harris**: De Vriesian mutation in the garden bean. The origin of the new race of beans seems most logically ex-

plained as a case of de Vriesian mutation. In this race the whole morphological organisation of the seedling has apparently been changed, and the race is characterised by a high degree of variability.—W. B. **Cannon**: Studies of ductless glands by the electrical method. The nerves distributed to the thyroid cells belong to the sympathetic, and not to the vagus, supply, and their effects are not indirect through alterations of blood flow. They are true secretory nerves.—E. B. **Wilson**: The distribution of the chondriosomes to the spermatozoa in scorpions. The chondriosome-material, having the same origin, fate, and (presumably) physiological significance, may be distributed to the germ-cells by processes widely different even in nearly related animals. In one of the scorpions the distribution is effected by a definite process of division, in the other by an operation that has at least the aspect of a hit-or-miss segregation, and one that gives only an approximate equality of result.—H. J. **Spinden**: New data on the archæology of Venezuela. Stone implements, including celts, pestles, etc., vessels and figurines of clay with painted and modelled decorations, personal ornaments of shell, nephrite, jet, and serpentine, as well as the petroglyphs and pictographs, occur in considerable quantity. The plastic art of Venezuela is one and the same with the "archaic art" already known in Central America and Mexico.—E. L. **Nichols**: Note on the phosphorescence of uranyl salts. For the only examples of luminescence which admit of detailed inspection, the spectrum of phosphorescence is identical with that of fluorescence, and it is suggested that this also applies to all phosphorescent materials. In spite of its great complexity, the luminescence spectrum of a uranyl salt is to be regarded as a unit, all its components decaying at the same rate after the cessation of excitation.—C. G. **Abbot** and L. B. **Aldrich**: The pyranometer: an instrument for measuring sky radiation. Two satisfactory types of this instrument, both derived in principle from the electrical compensation radiation instruments of the late K. Ångström, have been devised. Numerous others of the sky-radiation have been made. On fine days the sky-radiation alone received on a horizontal surface ranges from 0·07 to 0·13 calorie per square centimetre per minute.—M. B. **Porter**: Note on Lucas's theorem. A more general result than that obtained by Borel or Polya has been found.—H. S. **White**: A variable system of sevens on two twisted cubic curves.—G. H. **Parker** and E. G. **Titus**: The neuromuscular structure of sea anemones. There are four types of muscle action; they are of phylogenetic significance, and show that the neuromuscular mechanism of sea anemones is by no means so simple as originally supposed.—F. G. **Keyes** and W. J. **Winninghoff**: Change of the ionisation of salts in alcoholic solvents with the concentration. The present investigation on the conductance of sodium iodide and ammonium iodide in *iso*amyl alcohol and of sodium iodide in propyl alcohol was undertaken for two purposes: primarily to determine whether in these solvents, somewhat similar in nature to water, salts conform to the mass-action law at very small concentrations; and, secondarily, to test further the applicability of Kraus's empirical equation throughout the fairly wide range of concentration employed in the work.

BOOKS RECEIVED.

The Contingency of the Laws of Nature. By E. Boutroux. Translated by F. Rothwell. Pp. ix+196. (London: Open Court Publishing Company.) 5*s*. net.

Ruler and Compasses. By Dr. H. P. Hudson. Pp. 143. (London: Longmans and Co.) 6*s*. net.

The Emission of Electricity from Hot Bodies. By Prof. O. W. Richardson. Pp. vii+304. (London: Longmans and Co.) 9*s*. net.

The Animal Parasites of Man. By Dr. H. B. Fantham, Prof. J. W. W. Stephens, and Prof. F. V. Theobald. Pp. xxxii+900. (London: John Bale, Sons, and Danielsson, Ltd.) 45*s*. net.

The National Physical Laboratory. Report for the Year 1915–16. Pp. 80 + Figs. 7. (Teddington: W. F. Parrot.)

Measures for Avoidance and Extermination of Flies, Mosquitoes, Lice, and other Vermin. By Prof. H. Maxwell-Lefroy. Second edition. Revised for the Tropics. Pp. 17. (Calcutta and Simla: Thacker, Spink and Co.; London: Thacker and Co.) 1*s*. net.

Fire Protection for Passenger Ships. Pp. 44. (London: British Fire Prevention Committee.) 3*s*. 6*d*.

Geological Survey. Southern Coal-field. Maps and Sections. 10 maps. (Sydney: W. A. Gullick.)

Elements of Folk Psychology. By W. Wundt. Translated by Prof. E. L. Schaub. Pp. xxii+532. (London: G. Allen and Unwin, Ltd.) 15*s*. net.

British Forestry: its Present Position and Outlook after the War. By E. P. Stebbing. Pp. xxv+257. (London: John Murray.) 6*s*. net.

Commercial Egg Farming. By S. G. Hanson. Pp. 62. (London: Constable and Co., Ltd.) 1*s*. net.

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THURSDAY, AUGUST 3, 1916.

ORE-DEPOSITS.

The Deposits of the Useful Minerals and Rocks: their Origin, Form, and Content. By Dr. F. Beyschlag, Prof. J. H. L. Vogt, and Dr. P. Krusch. Translated by S. J. Truscott. Vol. ii., pp. xxi+515–1262. (London: Macmillan and Co., Ltd., 1916.) Price 20s. net.

THE first volume of this treatise was reviewed in NATURE for January 28, 1915 (vol. xciv., p. 583). The second volume completes the work so far as ore-deposits are concerned. The third volume does not appear as yet to have been published in Germany. Ore-deposits are classified according to their mode of origin as follows: magmatic segregations, contact-deposits, lodes, and ore-beds. The first volume dealt with the first two of these groups and with tin-lodes and quicksilver deposits belonging to the third. The second volume deals with lodes of gold and silver; lead, silver, and zinc; uranium; antimony; iron; manganese; copper; pyrites and arsenopyrites; nickel and cobalt. It concludes with an account of those ores which occur as beds in sedimentary deposits. Each section is preceded by a bibliography.

Gold-silver lodes are first described. The largest and richest of these occur in geologically young and chiefly Tertiary districts. The most striking examples are found in the Andes of Chile, Bolivia, and Peru, in the mountain ranges of Mexico, in the Great Basin of the United States, in the Sierra Nevada, and in the Rocky Mountains. Similar lodes are met with in Japan, in Sumatra, in Borneo, and in the Philippines. Examples occur in Europe in the Carpathians and in south-eastern Spain, where, as in the localities already mentioned, Tertiary igneous rocks abound; but not in the Alps and Pyrenees, where such rocks are absent. The evidence from distribution alone that they are in some way connected with vast outpourings of igneous rock—especially andesite and dacite—is therefore very strong, but it does not stand alone; other reasons are given, and finally the conclusion is reached that the young gold-silver lodes were formed by heated waters circulating towards the close of the eruptive activity in the district in which they occur, and that "these waters, together with their metal content, were derived directly from the eruptive magma." The view expressed in the sentence just quoted will certainly not be generally accepted if it must be taken to imply that the water is not of meteoric origin. Having dealt with the common characteristics and discussed the mode of origin of this important and widely distributed group of lodes the authors proceed to describe special cases. These local descriptions are illustrated by maps and diagrams, and in the more important cases contain particulars as to the development of the industry and of the amount and value of the ore raised. Take, for example, the case of Western Australia. The Kalgoorlie field was discovered at the beginning of the 'nineties. The economic conditions at the start were most unfavourable, supplies had to be obtained from Perth, more than 300 miles away, and water cost 2½*d.* a gallon. But in a few years all was changed. A railway was constructed between the two places, and also a pipe line capable of delivering 5,000,000 gallons of water per day. In 1909 Western Australia produced 1,595,263 oz. of fine gold, about one-fourteenth of the world's production, and not quite one-half of the total production of Australasia. Between 1903 and 1909, the last date for which figures were available when the book was written, there had been a continuous decline, which the authors attribute to decrease of value with depth. The corresponding figures for 1913, as quoted in Whitaker's Almanack, are 1,314,043 oz., so that the decline is still going on.

This goldfield has been examined by Dr. Krusch. The lodes are intimately associated with amphibolites, some of which are schistose and others massive. Although no evidence is given that any of the surrounding rocks are of Tertiary age, the authors refer the lodes to the younger series on account of their nature. They are described as veined zones consisting of a large number of small fissure-filings from which intense impregnation and replacement of the country rock have proceeded. The lode material consists chiefly of quartz containing auriferous pyrites with gold—and other tellurides in variable quantities. All the lodes are more or less decomposed near the surface, and where the gold is chiefly associated with sulphides two well-marked depth-zones occur: an oxidation zone from which most of the gold has been leached, and an abnormally rich cementation zone. On the other hand, where the gold is chiefly in the form of telluride no cementation zone exists, and the oxidation zone carries free gold exclusively.

The book then deals with the old gold lodes. These are not, as a rule, associated with eruptive rocks, quartz is by far the most abundant gangue mineral, and the country rock is rarely impregnated with metal, as is so frequently the case with the young gold-silver lodes. That quartz-veins carrying gold are more abundant and lodes of the Comstock type less abundant in the pre-Tertiary than in the Tertiary rocks is unquestionable, but it may be doubted whether, on this account, it is desirable to introduce age as a factor into the classification of ore-deposits. The gold-quartz lodes of California, Ballarat, the Barberton district of the Transvaal, and other areas are then described. The wonderful deposit of Mount Morgan is considered in this connection, and the various theories that have been advanced to account for it are discussed. The authors favour Rickard's view that it represents a highly altered part of a shattered country which has been saturated with mineral solutions and in part replaced by auriferous quartz; or, in other words, that it is one of the rare cases of a metasomatic gold-deposit.

Space prevents us from following the authors in their descriptions of the other metalliferous

lodes, but, in view of the fact that two of them are Germans, it may be interesting to note briefly what they say about the mineral resources of "German" colonies. Gold-bearing lodes occur in the contact-belts around different eruptives, mostly of a dioritic nature, near the village of Sekenke, in East Africa. They are lenticular in form, and five of them are payable, three of these constituting the Dernberg lode. The average assay of sixty samples, after rejecting those which yielded abnormally high results, gave 47 gm. per ton. These samples were taken from the cementation zone, which is of no great depth. The gold content of the primary zone does not appear to be sufficient to pay for working. In West Africa gold-copper ore is won on Swakop River, where a garnetiferous layer in gneiss is sparsely impregnated with copper. Auriferous copper deposits of a more important character occur on the Groot and Klein Spitzkop, some 20 km. to the north-west of Rehoboth. The copper-ore occurs sometimes as malachite, sometimes as chalcocite, bornite, or chrysocolla. The primary ore probably consists of pyrites and chalcopyrite. The gold occurs either as free gold or associated with pyrites. Wedges of country rock between converging veins have assayed 3 gm. to 4 gm. of gold and 20 gm. of silver per ton. Auriferous conglomerates have been observed in the Ussungo district, but they have not as yet proved to be of any economic importance.

In dealing with the world's production of gold and silver the authors estimate that the total yield from 1493 to 1911 was 20,737 tons, representing 2838 millions sterling, a small sum compared with the cost of the present war.

The volume concludes with an account of ore-bearing rocks interstratified with sedimentary deposits. This part commences with a description of the conditions under which stratified rocks are formed, and especially of those chemical and physical processes which throw light on the origin of ore-deposits. Then follow descriptions of iron-ore beds, of manganese beds, of copper-shale beds, of auriferous conglomerates, and finally of placer deposits yielding tin, gold, and platinum.

The treatise is a valuable addition to the literature of ore-deposits, and the translator deserves high praise for the way in which he has done his work.

NAPIER AND HIS LOGARITHMS.

Napier Tercentenary Memorial Volume. Edited by Dr. C. G. Knott. Pp. xi+441. (Published for the Royal Society of Edinburgh by Longmans, Green and Co., London, 1915.) Price 21*s.* net.

THE first place in this miscellany is naturally assigned to Lord Moulton's inaugural address. For once in a way, this is not an empty compliment; for the address is a model of what such an oration should be. There is only one mathematical formula in it, and this so simple and familiar to the audience that it did not need to be written down, while several important points are brought out with convincing lucidity. Of these are (i) that Napier, before publishing his "Canon," had arrived at the notion of a logarithm as a continuous function—we may even say, as one defined by a differential equation; (ii) that the essential property of the logarithm, in Napier's eyes, is that, if $a : b = c : d$, then $\log a \sim \log b = \log c \sim \log d$, so that a table with *numbers* as entries, and logarithms as extracts, will economise labour in doing rule of three sums.[1]

The papers contributed are, on the whole, more interesting and appropriate than is usual in productions of this kind. Of course, some of the contributors, however eminent, have little knowledge, and less interest, about the history of logarithms; so they either write an original note on an irrelevant subject (such as spherical harmonics) or a perfunctory page or so on relevant but well-known topics. As there are twenty-six technical papers, we cannot notice them all, but have to select those which seem to us most worthy of attention.

Among these are the two brief contributions by Prof. G. Vacca. One of these recalls the work of Pietro Mengoli; the other is, we think, vital to the whole question of what was the induction that led Napier to his goal. In Fra Luca Paciolo's "Summa de Arithmetica" (Venice, 1494) there is the following statement:—

"If you wish to know in how many years a sum of money will double itself at compound interest (paid per annum), divide 72 by the rate per cent. For example, if the rate of interest is 6 per cent., the number of years is 12."

No doubt this rule was obtained empirically; but the interesting thing is that we have a formula implying that the number of years required is inversely as the rate per cent. Now, Napier was a business man, and his *constructio* is essentially the formation of a table of compound *discount* at a very small rate per cent. We are convinced that this mercantile method contains the germ of Napier's invention, and not any trigonometrical formula. If we assume that, for a small fixed rate r,

$$A = (1+r)^{\alpha} \doteq 1 + \alpha r,$$

then with

$$B = (1+r)^{\beta},\ C = (1+r)^{\gamma},\ D = (1+r)^{\delta},$$

we have approximately

$$\frac{AD}{BC} \doteq \frac{(1+\alpha r)(1+\delta r)}{(1+\beta r)(1+\gamma r)} \doteq 1 + (\alpha + \delta - \beta - \gamma)r,$$

and now, if $A : B = C : D$, we have, to the same degree of approximation, $\alpha - \beta = \gamma - \delta$, which is Napier's fundamental theorem. We *now* know that if

$$\phi(x/y) = \phi(x) - \phi(y) + \phi(1),$$

then $\phi(x) = p \log_e x + q$, where p, q are constants. In Napier's original system, as Prof. Gibson points out (p. 128),

$$p = -10^7,\ q = 7.10^7 \log_e 10.$$

[1] For reasons given later, we entirely disagree with Lord Moulton's suggestion that the first germ of Napier's discovery is to be found in the expression for the difference of two cosines as the product of two sines.

These "logarithms" serve for rule of three sums, but they are *not* suitable for simple multiplications or divisions. Briggs appears to have seen how to amend the system by choosing 10 for the base, and 1 as the antilogarithm of zero. Whether the same idea had occurred to Napier is uncertain; at any rate, after consultation, the two men agreed upon the usefulness of the transformation, and Briggs performed the necessary computations. On all points in this connection Prof. Gibson's paper is very convincing and instructive. We do not suppose that either Briggs or Napier consciously thought of a base or a unit as we do, but they probably realised the meaning of a formula,

$$\lambda(x)=p \log (x)+q,$$

where $\lambda(x)$, $\log (x)$ are logarithms of the same number in two related systems. Here, again, Prof. Gibson's paper should be consulted.

We now come to the question of priority, which ought never to have been raised; it is astounding that even M. Cantor should prolong this idle controversy. Bürgi's table of *antilogarithms* appeared in 1620; his calculations appear to have been finished by 1610 (p. 209); Napier's table of *logarithms* appeared in 1619. Each table was the result of years of work; to convert either into the other, fraudulently, would involve a vast amount of labour; and there is not a shred of evidence that either man had access to the MS. of the other. It is the case of Newton and Leibniz over again in another form. So far as actual priority in publishing a table of logarithms is concerned, Edward Wright has a claim superior to that of either Napier or Bürgi; but he was sensible enough to know the difference between a special table constructed for use with Mercator's chart (essentially a $\log \tan \frac{1}{2}\theta$ table) and one adapted for general computation; even supposing that he knew, before the "Canon" was published, that his own table was a table of logarithms—which is extremely unlikely. Finally, Wright paid ample tribute to the genius of Napier, and never made any claim on his own account. This was reserved for the eccentric Benjamin Martin.

Among the other papers may be noted Dr. Glaisher's excellent paper on logarithms and computation; Prof. Sampson's careful bibliography of books exhibited; Dr. Knott's account of Edward Sang and his logarithmic calculations; Prof. d'Ocagne's notes on nomograms and multiplying machines; Mrs. E. Gifford's account of her new table of natural sines; papers on probability by Messrs. Erlang and Quiquet; and one on the arrangement of mathematical tables by Dr. J. R. Milne. In its way, the last is of outstanding importance, because everything possible should be done for those who have to use tables daily and for hours together; such things as paper, colour, typography, etc., are not the trifles they may seem to the amateur.

The general appearance of the volume is excellent; it is well printed, and the illustrations (two in colour) are most interesting; the indexes are ample, and the price is not extravagant. The biography of Napier has been well done by Dr. P. Hume Brown, and Mr. G. Smith has contributed a careful account of Merchiston Castle. The editor (Dr. Knott) may be congratulated on the result of his labours. G. B. M.

AN AGRICULTURAL POLICY.

Agriculture after the War. By A. D. Hall. Pp. vii + 137. (London: John Murray, 1916.) Price 3*s*. 6*d*. net.

IN this little book Mr. Hall sets out his views as to the methods to be adopted after the war in order to develop agriculture to the full extent demanded by the national necessities. Mr. Hall insists that more food must be grown at home as an insurance in time of war, to develop our resources and reduce our foreign indebtedness, and to increase the agricultural population as a specially valuable element in the community. This can be attained only by bringing more land under the plough. Farmers will not on their own responsibility plough up grass land: to do so is to destroy a certain, though small, source of profit for the sake of a more risky, but possibly larger, one. Mr. Hall considers that the old *laissez-faire* policy will no longer meet the case: the State may be driven to adopt some system of bounties or protective duties to make the profits more certain and the inducements more tangible. Five methods are outlined for obtaining a more intensive cultivation of the soil: the establishment of large industrial farms working on a considerable area with all the economic advantages of organisation and scientific management; the establishment under certain conditions of colonies of small holders working under co-operative organisation; the intensification of existing methods; the reclamation and settlement of waste and undeveloped areas; and the establishment of certain subsidiary industries.

Mr. Hall's writings are always marked by breadth of view and saneness of outlook, and it is gratifying to know that these have not deserted him since he left the country for Dean's Yard. He has never hesitated about a proposal because it happened to be rather revolutionary, nor does he do so here. The scheme suggested is comprehensive and logical, but it has its revolutionary aspect, and the final solution, in his own words, is "for the State to become the ultimate landowner."

It is undeniable that the land is not producing as much as it might do. It is equally undeniable that no comprehensive attempt has been made to get it to do so. Almost every estate has an amenity value and a sporting value in addition to its agricultural value—thus the land has to serve three masters. Trees, hedgerows, grass, parks, plantations, warrens, are all kept up, even when they are in direct conflict with the agricultural productivity of the land. To make matters worse, the farmer lacks the manufacturer's certainty of return. The manufacturer works on a contract; he knows precisely how much he will be paid, and what output he may

expect; he usually has a quick return for his outlay, and he can insure against many of his risks. The farmer, on the other hand, rarely, if ever, works on a contract; he starts expending money in August on a crop that will not be sold for fifteen months; he does not know definitely what price he will receive, or what yield he will get. The whole thing is a hazard, and he cannot insure against his risks. Consequently he has to allow a large margin for safety, and he balances his risk on the arable land by having a considerable area of grass on which the risk is at a minimum.

The application of scientific methods has decreased the risk and increased the effectiveness of the capital involved, but, of course, it cannot deal with the great factor of price. This problem is for the statesman, and when he comes to deal with it he will find Mr. Hall's book a useful guide. E. J. R.

OUR BOOKSHELF.

The New Public Health. By Prof. H. W. Hill. Pp. x+206. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 5s. 6d. net.

THE object of this book is to bring before the general public the newer conceptions of the aims and methods of public health. The older public health mainly dealt with the environment; the newer is chiefly concerned with the individual. The old teaching stated that infectious diseases were generated in the foul, ill-smelling, unventilated, sunless hovels of the slums; that a pinhole leak in some plumbing fixture accounted for diphtheria or typhoid fever; that dampness caused malaria, and impure water yellow fever. The new teaching begins and usually ends with the search for (*a*) the infected individual, (*b*) the routes of spread of infection from that individual, (*c*) the routes of disposal of the excreta of the community, by which, if infection occur, the infecting agent might reach the members of the community. To locate all the infective individuals of the community and to guard all their discharges is the ultimate goal of modern preventive measures.

The author surveys the sources, routes, and control of infectious diseases, the old and the new practice in the control of epidemics, and individual and community defence and administration. The book is written in a vigorous and trenchant style which arrests the attention and carries conviction. The only criticism of it that might be passed is that the casual reader might gather that such factors as garbage heaps and ill ventilation are of little moment to the public health, whereas actually the author indicates that they are not to be neglected, though their importance and significance are very different from what used to be considered to be the case. R. T. H.

The Pathology of Tumours. By Dr. E. H. Kettle. Pp. viii+224. (London: H. K. Lewis and Co., Ltd., 1916.) Price 10s. 6d. net.

IN this book the author gives an excellent account of the characters, occurrence, and general pathology of tumours, innocent and malignant. No doubt students and practitioners will find it of considerable service, though it may be remarked that we fail to find in it any novelty in matter or arrangement, or anything that has not been just as adequately stated in some other books that could be named. The illustrations, however, are both numerous and excellent, and this feature will probably be the one which will recommend the book.

In the opening chapters the general biology of tumours is dealt with, including statistics of occurrence, the experimental study of tumour growth, and the general principles of treatment. Here, however, we fail to find any reference to changes in the body fluids which occur in malignant disease, such, for instance, as alterations in the anti-tryptic power and lipoclastic action of the blood-serum.

In the second part the naked-eye and microscopical characters of the different forms of tumours are described, and finally the occurrence of tumours in the various organs and tissues of the body is detailed. Altogether the book gives a very practical summary of tumour formation and development in general.

Harper's Hydraulic Tables for the Flow of Water, in Circular Pipes under Pressure, Timber Flumes, Open Channels, and Egg-shaped Conduits, with much Accessory Information. By J. H. Harper. Pp. 192. (London: Constable and Co., Ltd., 1916.) Price 8s. 6d. net.

WITH painstaking assiduity, the author has worked out, with the aid of certain well-established formulæ, what he terms a "grill" or network of solutions, covering such problems as are likely to arise in actual practice "regarding the flow of water in either closed or open conduits, with any reasonable assumption of rugosity and with any rational arrangement of grade, in quantities from a small fraction of a foot to several thousand feet per second." The formulæ selected are those of D'Arcy, Bazin, and Kutter—all authoritative in their degree, but labouring under the disadvantage of possessing extremely variable coefficients, which render their application a matter of some difficulty, quite apart from the complexity of the expressions themselves. It has recently been shown by Mr. A. A. Barnes that the inherent cause of this diversity lies in the strict adherence to the fundamental equation of Chezy, viz. $v=c\sqrt{rs}$, and that if the equation were written in the form $v=cr^{\alpha}s^{\beta}$, coefficients could be determined which are simple in character and constant for the same class of channel. For those who prefer older methods the volume will undoubtedly prove of use in obviating the necessity for working out experimental cases in detail. Within the range of the tabulated results, it is easy to interpolate values sufficiently correct for preliminary approximations. The tables are also diagrammatically expressed in charts, and there are some supplementary notes on hydraulic formulæ generally, which make the book a succinct little manual on the subject. B. C.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Productive Work and Classical Education.

AT this time people are awakening to the mischief that has been done to this country by the neglect of science as a part of education, and there seems a danger of the pendulum of opinion swinging too far, and of classics being looked upon as something to be completely eliminated from the educational curriculum. In relation to this, I think a short personal anecdote may be instructive. In 1868 I had the privilege of working with the late Prof. Willy Kühne as his only student in his laboratory in Amsterdam, and the friendship which began there continued up to the time of his death.

Prof. Kühne was a most remarkable man. He was, I think, one of the greatest physiological chemists of last century, and was quite half a century in advance of nearly all his contemporaries. Belonging to a rich banking family, he could go where he pleased, do what he pleased, and obtain any optical or other apparatus he needed, regardless of cost. He accordingly elected to work with Claude Bernard, and used the chemical and microscopical skill which he acquired to such advantage that at an age when most men are only thinking of beginning university life he had produced a monograph on protoplasm and contractility ("Ueber Protoplasma und Contractilität"), which was not only far in advance of anything then in existence when it was written, but still remains unrivalled half a century later.

His great ability led to an invitation to become professor of physiology at Amsterdam. After some years he was invited to occupy the chair at Heidelberg rendered vacant by the transference of Prof. H. von Helmholtz to Berlin. This invitation he accepted, and remained at Heidelberg until his death.

Such a career seems ample vindication of the claim that classics is unnecessary to education, more especially if it be borne in mind that Kühne was an exceptionally good linguist, speaking three or more languages with perfect ease, that he had travelled much in Europe, and was a perfect encyclopædia of knowledge and criticism in painting and sculpture. Yet there was one bitter drop in his cup of knowledge and honour. The nature of this was confided to me as a strict secret by our mutual friend, Prof. Hugo Kronecker, when we were discussing together some data for a short life of Kühne which Kronecker thought of writing. As both Kühne and Kronecker are dead, there is no further reason for preserving the secret, which I for one never could have suspected. It was that Kühne had felt deeply the scorn with which some people had regarded him because he had never taken a classical degree. Fools they were no doubt, but their attitude probably indicated the mental attitude of the mass of German graduates to whose devotion to a scientific education we are now inclined to attribute much of Germany's success.

LAUDER BRUNTON.

1 De Walden Court, New Cavendish Street, London, W., July 15.

Gravitation and Temperature.

DR. P. E. SHAW's striking experimental result (*Phil. Trans.*, 1916) as to *a variation* of gravitational attraction with temperature of the *large* mass, and that of Poynting and Phillips as to *no variation* in attraction with temperature of the *small* mass, may seem reconciled satisfactorily by the formula put forward by the latter collaborators, and quoted by Dr. Shaw in NATURE (July 13), viz. :—

$$F=G\left(1+\kappa\frac{MT+mt}{M+m}\right)\frac{Mm}{r^2}\quad . \quad . \quad . \quad (1)$$

where T and t are the absolute temperatures of the masses M and m respectively, placed at a distance r apart. But it seems desirable to notice that this formula does not in general allow of the derivation of the attraction of a finite mass from the attractions of its component particles in the usual way by vector addition.

Thus, for a pair of particles, each of mass m, at temperatures T and t, and placed r apart, we have as the attraction :—

$$F_1=G\left(1+\kappa\frac{T+t}{2}\right)\frac{m^2}{r^2}\quad . \quad . \quad . \quad . \quad (2)$$

Again, the attraction of *two* particles, each of mass m, close together, and at temperature T, on a single particle of mass m and temperature t at a distance r, would be :—

$$F_2=G\left(1+\kappa\frac{2T+t}{3}\right)\frac{2m^2}{r^2}.\quad . \quad . \quad . \quad (3)$$

Hence, F_2 is not, in general, equal to

$$2F_1\quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

For the effective temperature of the system varies between those of the particles, according to their relative masses, just as the position of the centre of mass of a system varies among those of its particles according to their masses.

Accordingly, the component attractions do not sum to their resultant in the usual way.

Of course, this is no disproof of the formula, but must be regarded simply as a somewhat grave consequence involved by the formula. It is indeed a consequence that may well give us pause before accepting the formula, pending either (*a*) a rigorous derivation of the formula theoretically, or (*b*) some crucial experimental evidence that it is preferable to other formulæ.

Suppose, instead of formula (1), we try the following :—

$$F=G(1+\alpha\theta)\frac{M(1+\beta T)m(1+\beta t)}{r^2}\quad . \quad . \quad (1a)$$

where, as before, T and t are the absolute temperatures of the masses M and m, and θ is the mean, or effective, temperature of the space, whether vacuous or not, between the masses.

It is to be noted that, with Max Planck's theory of entropy, a temperature is now theoretically assignable to a vacuous space which is a field of radiation. Using this different formula for the cases already considered, if one particle at temperature t is attracted by one or two particles at temperature T, we have the relations :—

$$F_1=G(1+\alpha\theta)(1+\beta T)(1+\beta t)\frac{m^2}{r^2}\quad . \quad (2a)$$

$$F_2=G(1+\alpha\theta)(1+\beta T)(1+\beta t)\frac{2m^2}{r^2}\quad . \quad (3a)$$

So here, $$F_2=2F_1\quad . \quad . \quad . \quad . \quad . \quad . \quad (4a)$$

And, however we vary the mass at temperature T, *provided the temperature θ remains unchanged*, the attraction on the single particle would vary in direct proportion to the attracting mass.

This new formula, then, restores the validity of the vector addition of the component attractions. It seems, however, at first sight to have lost the power

to explain the contrasted experimental results of the temperature effect of the large mass, and the lack of it in the small mass. For, obviously, the temperatures of the masses may now be interchanged without altering the value of the attraction if only the value of θ is constant.

But, in the actual experiments by Dr. Shaw, might not the heating of the large mass near the small one possibly involve an increase of θ? And again, in the heating of the small mass carried out by Poynting and Phillips, the earth itself being the large mass, might not the value of θ be practically constant? If so, possibly the formula (1a) here suggested might prove consistent with all the experimental results just reviewed.

E. H. BARTON.

Nottingham, July 18.

The Gun-firing on the Western Front.

IN NATURE for July 13 Dr. C. Davison directs attention to Dr. van Everdingen's investigations with regard to the propagation of sound, and he also refers to the inaudibility of the reports in the face of a gentle wind when the observer was comparatively near. In this neighbourhood the sounds are heard distinctly when a quiet situation is found, but a very marked peculiarity is the fact that the direction of the wind seems to make no appreciable difference in the intensity of the sound. For example, on July 19 the booming was very intense and quite easily heard with the wind blowing from the north-west. On the 20th, with the wind from the east, the audibility was no greater, possibly not so great. Westerly winds have been frequent of late, but have not diminished the sounds at all, whereas it is a fact that on some occasions with an easterly wind no sounds were heard. It is, of course, impossible to say whether there was firing or not on these latter occasions, but it is certainly worth recording that on the majority of the occasions upon which I have heard the sounds since the end of 1914 I have at the same time observed that the wind was westerly.

Presumably in this neighbourhood we are beyond the silent zone, and in the second-sound area, and the suggestion seems to be that in this area the effect of wind is negligible. Two further points worth noting are the facts that the sounds here are practically as intense as at Brighton, though we are about fifty miles farther from the source, and also that the direction of the source is always fairly obvious.

The sounds being so distinct here, and having lost so little intensity in the fifty miles which lie between this neighbourhood and Brighton, it seems likely that they should still be audible at much greater distances. Possibly they could be traced to very extreme distances with the aid of some very sensitive sound detector, if any suitable instrument is available.

It would also be interesting to get evidence from aeronauts. Plenty of balloons are in use now, and doubtless the sounds have been noted, if audible.

C. WELBORNE PIPER.

Blackheath, S.E.

Portraits of Wm. Smith.

IN Phillips's "Memoirs of Wm. Smith," the father of English geology, p. 125, reference is made to his portrait, taken in 1805, by Solomon Williams, and another by Jackson, and still another by Fourau, the last presumably being now in the Geological Society's rooms. So far I have been unable to trace the portraits by the two first-named artists. Can any of your readers assist me?

T. SHEPPARD.

Museum, Hull.

NATIONAL AFFORESTATION.

SIR W. SCHLICH, in an important article in the *Quarterly Journal of Forestry* for July, urges the importance of afforestation and discusses the measures which should be taken to secure for the nation a sufficient supply of timber in the future. The quantity of timber used in the United Kingdom is enormous, and increases year by year. In addition to the home production, estimated at about 2,000,000 loads annually, there was an import of 11,590,318 loads, valued at 33,788,884*l.*, in 1913, as compared with 10,104,504 loads, worth 25,676,988*l.*, in 1899. Only 10 per cent. of the total timber imported in 1913 came from British possessions, as against 22 per cent. in 1899. All these figures relate solely to the raw material, timber; but there must be added wood manufactures to the value of 3,583,187*l.*, and wood-pulp estimated at 4,617,739*l.*, entering our ports in 1913. We draw our main supplies from Russia, Sweden, Norway, France, the United States, and Canada. In all these countries, except Russia and Canada, the tendency in the future will be towards restricted production, diminished export, and increasing prices of timber, owing to the annual growth in the forests not being sufficient to replace what is taken away by cuttings and by forest fires. Our main imports are coniferous timber, pitwood, and wood-pulp, three classes of forest produce which can be profitably produced in our climate. A review of the whole situation shows that a considerable increase in the area under timber in the United Kingdom would be economically sound, and would also serve as an insurance against an unexpected timber famine brought about by international complications in the future.

Sir W. Schlich discusses at length the amount and nature of the land available for afforestation. As most forest work is done in winter, when agricultural work is slack, a scheme of afforestation will provide extra labour for agriculture in spring and summer, and consequently will be a considerable help to increased productivity of the land generally. This point is of especial importance in connection with small holdings, and should be taken into account when considering schemes for the settlement of discharged soldiers after the war. Very large continuous forest tracts are not necessary. Small blocks of woodland, with a minimum area of 500 acres, scattered over the country in the vicinity of small holdings, make an ideal combination. Sir W. Schlich summarises his proposals for afforestation as follows :—

(1) The afforestation of not less than 3,000,000 acres of surplus land, by planting about 30,000 acres a year.

(2) Private proprietors, Corporations, and the State should take part in the work of afforestation, the State doing that part which the other two agencies are not willing or able to undertake.

(3) Financial assistance should be given to private proprietors in the work of afforestation, if necessary, by making advances to them at the rate of interest at which the State can take up money.

To secure success from the very outset it is essential

to create a separate branch for forestry in the Board of Agriculture to deal with all forestry questions. There should be a Director of Operations, occupying the post of Joint Secretary or Assistant Secretary, to begin with. He should be a duly qualified forest expert, and be assisted by an adequate number of trained inspectors to supervise the field work. Well-considered plans of operations must at once be drawn up for each block, laying down the order of planting, deciding the selection of species to be planted according to the quality of the soil in each subdivision, drawing up a network of roads for future transport, to be constructed when required, and other matters.

A NATIONAL STATUTORY BOARD OF SCIENCE AND INDUSTRY.

WE have received for publication from the British Science Guild the following memorandum on the relations which should exist in future between the State and science, and suggesting that a national statutory Board of Science and Industry should be formed. The memorandum, which has been forwarded to the Government, is signed by some 220 of the most important representatives of industry, science, and education :—

The British Science Guild, which was founded in 1905 with the object of bringing home to all classes "the necessity of applying the methods of science to all branches of human endeavour, and thus to further the progress and increase the welfare of the Empire," is of opinion that the present European crisis affords a unique opportunity for impressing upon all who are engaged in the executive functions of government, as well as upon those who are concerned with industry and commerce, the paramount importance of scientific method and research in national affairs.

There has been much discussion upon these matters, and the following conclusions are submitted by the Guild as representing authoritative opinion :—

A. The material prosperity of the civilised world during the past century is mainly due to the application of science to practical ends.

B. While we stand high among all nations in capacity for original research, as represented by the output of our scientific workers, this capacity has been comparatively little utilised in British industry.

C. The State has neglected to encourage and facilitate scientific investigation, or to promote that co-operation between science and industry which is essential to national development.

D. Modern conditions of existence demand that instruction in science, and training in scientific method, should be a fundamental part of education.

E. The present control of all stages of educational work, from the primary school to the university, mostly by men who have an inadequate appreciation of the meaning and power of science, is largely responsible for the unsatisfactory preparation commonly provided for the work of life.

Since its foundation the British Science Guild has urged that, in the interests of national welfare, serious attention should be given to these defects, and steps taken to remedy them. The establishment of the scheme for the development of scientific and industrial research, under a Committee of the Privy Council, is a welcome recognition of the intimate relations between scientific investigation and industrial advance; and the Advisory Council which advises the Committee as to the expenditure of the sums provided by Parliament, amounting for the year 1916–17 to 40,000*l*., has already been responsible for the institution of researches which should lead to most valuable industrial results. The outlook of the Council may, however, be extended profitably in several directions; for it should be even more comprehensive than that of the Development Commission, which provides for the development of rural industries, among other matters. This Commission, with the Board of Agriculture and Fisheries, and the Imperial Institute, which has recently been transferred from the Board of Trade to the Colonial Office, is not concerned directly with manufacturing industries, upon which so large a part of the nation's prosperity depends.

The field of the Privy Council Committee and its Advisory Council is thus distinct from that of any existing State department; and it should embrace all progressive industry and science. It is suggested that a Board or Ministry is necessary to discharge the functions indicated in Clause I. of the recommendations subjoined, in such a way as to fulfil modern requirements.

I. A national statutory Board of Science and Industry, the permanent staff of which should consist mainly of persons of wide scientific knowledge and business experience, should be established to:—

(1) Promote the co-ordination of industrial effort.

(2) Secure co-operation between manufacturers and all available laboratories of research.

(3) Co-ordinate, and be the executive centre of, such joint scientific committees as have been formed by the Royal Society, the Chemical Society, and various trade and educational associations.

(4) Undertake inquiries as to products and materials, and generally to serve as a national bureau of scientific and industrial intelligence.

(5) Collect and publish information of a scientific and technical character; and provide so far as possible for the solution of important problems bearing upon industry.

(6) Institute a number of paid advisory committees consisting of men of wide scientific knowledge assisted by expert investigators and technologists who should receive reasonable fees for their services.

(7) Organise scientific effort on the manufacturing side and in commercial relations with other countries.

(8) Arrange measures for the mobilisation of the scientific, industrial, and educational activities of the nation so as to ensure ready response to national needs and emergencies.

(9) Encourage investigation, and, where necessary, give financial aid towards the synthesis and artificial production of natural products and for other researches.

Such a Board would naturally administer the scheme of the Privy Council Committee, as well as take over certain functions of existing departments and boards.

The functions of the Board would be much the same as regards the promotion of scientific and industrial research and training, the co-operation of universities with industries through trade associations, and the maintenance of a record of scientific and technical experts, as outlined in the report on "British Trade after the War" by a Sub-Committee of the Board of Trade.

II. In all departments of State in which scientific work is carried on, adequate provision should be made for the periodical publication and wide distribution of bulletins, leaflets, and reports, so that increased public interest and attention may be encouraged in the results.

III. Every industrial undertaking, subsidised or otherwise assisted by the State, should have upon its board of directors men who possess expert scientific knowledge of the business in which they are engaged.

IV. In order to develop industries which especially require the services of scientific workers, adequate remuneration and improved prospects should be offered by the Government, by municipal corporations, and by manufacturers to men who have received an effective scientific training. Means should be found of compensating and rewarding persons whose researches have proved of decided national or public advantage without being profitable to themselves.

V. A knowledge of science should be regarded as an essential qualification for future appointments in the departments of the public service concerned with industrial, scientific, and technical developments. The Royal Commission on the Civil Service recommended in 1914 that a Committee should be appointed to consider the present syllabus of subjects of examination for clerkships (Class I.). This Committee should be constituted without delay, and science as well as other branches of modern learning should be adequately represented upon it, and upon the Civil Service Commission itself.

VI. Measures should be taken to revise the educational courses now followed in the public schools and the Universities of Oxford and Cambridge.

VII. In elementary and secondary schools supervised by the Board of Education, more attention should be given to scientific method, observation, and experiment, and to educational handwork.

THE NATIONAL RESEARCH COUNCIL OF THE UNITED STATES.

Preliminary Statement.

In response to a request from the President of the United States, the National Academy of Sciences has undertaken to organise the scientific resources of educational and research institutions in the interest of national preparedness.

Public welfare and national security depend upon industrial progress and military efficiency, and these in turn result from practical applications of scientific knowledge. A superstructure, no matter how perfect, must have firm foundations, and thus the development of our industries must go hand in hand with the advancement of science through research.

Euclid, working out problems in pure mathematics in Alexandria, prepared the way for the calculations of the engineer. Galileo, discovering the satellites of Jupiter, convinced the world of the truth of the Copernican theory, broke down absurd medieval conceptions which prevented scientific progress, and stimulated exploration and advance in every field. Pasteur, studying the optical properties of certain crystals with no thought of practical result, was led to his investigations of bacteria and his epoch-making discoveries for the benefit of mankind.

Thus scientific research in the laboratory, whether for the advancement of knowledge or for direct industrial application, is a most fundamental form of national service, which should be encouraged by every possible means. Since the beginning of the war this fact has been recognised in England by the creation of a Scientific Council, and in Australia by the establishment of a National Institute of Science and Industry. Both bodies will devote their efforts to the promotion of scientific and industrial research.

Organisation of the National Research Council.

During the Civil War the need of scientific advice was clearly recognised by our Government. Accordingly the National Academy of Sciences was chartered in 1863 by Act of Congress, which stipulated that "the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art. . . ." During the war, and frequently in later years, the Academy has been consulted by Congress, by the President, and by various members of his Cabinet.

The Naval Consulting Board, recently appointed by the Secretary of the Navy, has recommended the establishment of a naval experimental and testing laboratory and taken steps of far-reaching importance in the mobilisation of the industrial resources of the nation. The National Academy is now requested by the President to organise the extensive scientific resources of existing research laboratories in the interest of preparedness. To this end it has established a National Research Council.

The *purpose* of the Council is to bring into co-operation existing Governmental, educational, industrial, and other research organisations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defence, and such other applications of science as will promote the national security and welfare.

Membership.—The Council will be composed of leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution, and various scientific bureaux of the Government; educational institutions and research endowments; and the research divisions of industrial and manufacturing establishments.

In order to secure a thoroughly representative body, the members of the Council are being chosen in consultation with the presidents of the American Association for the Advancement of Science, the American Philosophical Society, the American Academy of Arts and Sciences, the American Association of University Professors, and the Association of American Universities, and with the advice of a special committee representing the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Electrical Engineers, and the American Chemical Society. Members of the Cabinet will be asked to name the representatives of the various departments of the Government.

Research committees of two classes will be appointed: central committees, representing various departments of science, comprised of leading authorities in each field, selected in consultation with the president of the corresponding national society; local committees in co-operating institutions engaged in research.

The Council of the Academy will recommend to the National Research Council the following plan of procedure, subject to such modification as may seem desirable:—

(1) The preparation of a national inventory of equipment for research, of the men engaged in it, and of the lines of investigation pursued in co-operating Government bureaux, educational institutions, research foundations, and industrial research laboratories; this inventory to be prepared in harmony with any general plan adopted by the proposed Government Council of National Defence.

(2) The preparation of reports by special committees, suggesting important research problems and favourable opportunities for research in various departments of science.

(3) The promotion of co-operation in research, with the object of securing increased efficiency; but with careful avoidance of any attempt at coercion or interference with individual freedom and initiative.

(4) Co-operation with educational institutions, by supporting their efforts to secure larger funds and more favourable conditions for the pursuit of research and the training of students in the methods and spirit of investigation.

(5) Co-operation with research foundations and other agencies desiring to secure a more effective use of funds available for investigation.

(6) The encouragement in co-operating laboratories of researches designed to strengthen the national defence and to render the United States independent of foreign sources of supply liable to be affected by war.

Co-operating Bodies.—Arrangements have been made which assure the Council of the hearty co-operation and support of members of the Cabinet and other officers of the Government; the officers of many national societies; the heads of the larger universities and research foundations; and a long list of the leading investigators in Government bureaux, research foundations, industrial research laboratories, and educational institutions.

From the cordial interest shown by all those who have learned of the work in its preliminary stages, it is evident that as soon as a widespread request for co-operation can be extended it will meet with general acceptance.

EDWIN G. CONKLIN,
SIMON FLEXNER,
ROBERT A. MILLIKAN,
ARTHUR A. NOYES,
GEORGE ELLERY HALE, *Chairman.*
(*Organising Committee.*)

PSYCHOLOGICAL EFFECTS OF ALCOHOL.[1]

THE literature on the alcohol question is already vast, but it promises to be bigger still if the ambitious programme of Prof. F. G. Benedict and his colleagues is accomplished to the full. It must be more than thirty years ago that, feeling the tyranny of the ultra-teetotal party in America, the late Prof. Atwater founded a famous committee with the object of freeing, at any rate, the scientific section of the community from the limitations of opinion and research on the question which the so-called temperance party sought to impose upon them. Excellent work they did, but in the intervening years the methods of research have been so improved that the work of that committee urgently needed revision. So in January, 1913, Prof. Benedict invited the co-operation of physiologists throughout the world to share in a gigantic investigation of the numerous problems presented by the dietetic use of alcoholic beverages, and obtained sympathetic answers from a large number of eminent people in all countries. In the present volume a long list is given of these, and grateful acknowledgment is made of friendly, helpful letters from the majority of them.

This appears to have completed the measure of their co-operation, and Prof. Benedict, so far as actual work is concerned, has been left to tread an almost lonely furrow. The brochure from the pen of himself and Dr. R. Dodge deals only with quite a limited branch of the subject, but the results obtained are of considerable importance. The experiments were performed with moderate doses of alcohol (30 to 45 c.c.), and were carried out with great perfection of technique and with proper controls. The majority of the subjects were normal young men, a few were psychopathic owing to previous misuse of alcohol, fewer still were the number of actual teetotalers who consented to lend themselves to the experiment, and one only was a confirmed heavy drinker; the results obtained with him can be left out of account, as he soon rebelled against a limitation of his usual supply of whisky. Otherwise, with differences in detail, the main results were the same in all cases.

The principal question investigated was whether or not these small doses of alcohol produced any delay of, or interference with, various neuro-muscular processes, and the selected processes were some of them simple, such as the knee jerk, others more complex, such as reflexes, in which the eyes were concerned, and others, still more complicated, involved mental operations, such as association of ideas and memory. Electrocardiograms and pulse records were also taken, and the cardiac acceleration noted was found to be due to a depression of the inhibiting mechanism. The answer to the main inquiry is certainly a rather unexpected one, so insistent are the claims of the teetotalers that even a moderate drinker is putting an enemy into his mouth to steal away his brains. For it was found that, whereas these small doses of the drug depressed the simplest reflex actions, such as the knee jerk, the more complex the neural arc involved in a reflex, the less was this effect manifested, whilst in operations involving mental work and memory the effect was either nil or an improvement was noted. In other words, the lower centres (*e.g.*, the vagus centre and the knee-jerk centre in the lumbar cord) are depressed most, and the highest least. "If alcohol had selectively narcotised the higher centres it would have been used as an anæsthetic centuries ago."

W. D. H.

[1] "Psychological Effects of Alcohol: an Experimental Investigation of the Effect of Moderate Doses of Ethyl-alcohol on a Related Group of Neuro-muscular Processes in Man." By Raymond Dodge and Francis G. Benedict. Pp. 281+32 figures. (Carnegie Institution of Washington. Publication No. 232. 1915.) Price 2.50 dollars.

THE FUNERAL OF SIR WILLIAM RAMSAY.

THE funeral of Sir William Ramsay took place at Hazlemere, High Wycombe, on Wednesday, July 26, in the presence of a large and representative gathering comprising very many who had been students of his. The congregation included:—Sir J. J. Thomson and Prof. Emerson Reynolds (representing the Royal Society); Prof. F. G. Donnan, Prof. E. G. Coker, Prof. A. R. Cushny, Prof. G. D. Thane, Prof. J. A. Platt, Dr. S. Smiles, Mr. H. Keene (acting treasurer), and Dr. W. W. Seton (secretary) (representing University College, London); Dr. Alexander Scott, Sir W. Tilden, Sir J. Dobbie, Lieut.-Col. A. Smithells (also representing the University of Leeds), Prof. Liversidge, Prof. J. M. Thomson (also representing King's College, London), Prof. Frankland (also representing the University of Birmingham), Prof. H. E. Armstrong, Prof. J. F. Thorpe, Prof. W. H. Perkin (also representing Magdalen College, Oxford), and Prof. Phillips (representing the Chemical Society); Sir Boverton Redwood, Sir A. Pedler, Lady Napier Shaw, and Mr. R. Mond (representing the British Science Guild); Sir Philip Magnus and Prof. H. Jackson (representing the University of London); Sir Henry Craik, M.P. (representing the University of Glasgow); Prof. Philip and Dr. Schryver (representing the Imperial College of Science and Technology); Prof. C. Lloyd Morgan (representing the University of Bristol); Mr. T. F. Burton (representing the Society of Chemical Industry); Mr. A. Chaston Chapman (representing the Society of Public Analysts); Dr. L. Thorne (representing the Institute of Brewing); Prof. A. M. Worthington, Sir Napier Shaw, Sir Edward and Lady Brabrook, Dr. Veley, Dr. J. A. Harker, Mr. O. Hehner, Dr. W. Gray, Sir J. Mackenzie Davidson, Dr. G. Carey Foster, Dr. G. Senter, Dr. Morris W. Travers, Dr. Lewis Reynolds, Mr. W. Macnab, Mr. G. McGowan, Dr. J. Scott Keltie, and Mr. and Mrs. R. Priestley. The last-named, it is of interest to note, in addition to paying their personal tribute of respect, represented the family of the great chemist Priestley. We understand that telegrams of condolence were received from the Franklin Society, the New York section of the Society of Chemical Industry, the Principal of Houston University, Texas, and the President of the Instruction Publique de France, also many letters and telegrams from the presidents and secretaries of various learned societies among the Allies, and that a wreath has been, or is being, sent by the Chemical Society of France. The foregoing list, which does not aim at completeness, testifies to the esteem and affection felt for the great man of science whose remains were laid to rest a week ago.

DR. J. A. HARVIE-BROWN.

THE ranks of naturalists have suffered a great loss through the death of Dr. J. A. Harvie-Brown, who took for many years an active and effective interest in ornithology and faunistic studies. He was born at Dunipace in Stirlingshire in August, 1844, and died there on July 26 last. He studied at the universities of Edinburgh and Cambridge, travelled widely in Norway, Russia, Transylvania, and elsewhere, and had a very intimate acquaintance with Scotland. A very active man in early life, and keen with his rod and gun, he was for many years unable to move about much, and was but little known, except by his writings, to the younger naturalists. To the end, however, he kept up his interests, and was a very good correspondent. His generous recognition of the work of other naturalists was very characteristic, and he was always ready to give assistance from his extraordinary store of information. He had a very high standard of precision and cautiousness of statement, and was not slow to winnow wheat from chaff, but there was always good-humour behind his tonic criticisms. Dr. Harvie-Brown had a very extensive and accurate knowledge of birds and their habits, and was particularly interested in problems of distribution and migration. His studies of the capercaillie, the squirrel, the fulmar, and so on are models of their kind. He was for many years one of the editors of the *Annals of Scottish Natural History,* and continued his assistance when that became, in 1912, the *Scottish Naturalist.* The number of articles and notes that he published in those journals and elsewhere was enormous. Dr. Harvie-Brown will be most remembered as the editor of, and chief contributor to, the well-known series of volumes on the "Vertebrate Fauna of Scotland." Along with Mr. T. E. Buckley, he wrote the volumes on Sutherland, Caithness, and Cromarty (1887), the Orkney Islands (1891), Argyll and the Inner Hebrides (1892), the Moray Basin (1895), and he was alone responsible for that dealing with the Tay Basin and Strathmore (1906). The fine workmanship of these volumes is widely recognised. Dr. Harvie-Brown was a landed proprietor, and a good instance of the gentleman of leisure who worked hard at ornithology and came to have an expert knowledge of some of its aspects. In 1912 he received the honorary degree of LL.D. from the University of Aberdeen in recognition of his contributions to a knowledge of the Scottish fauna.

NOTES.

THE second National Exposition of Chemical Industries will be held in New York on September 25–30. During the same week the annual meeting of the American Chemical Society will take place. The meetings of the American Electrochemical Society will be held on September 28–30.

ON Wednesday, July 26, the memorial to Sir William White, promoted by the Institution of Naval Architects, was formally handed over to the council of the Institution of Civil Engineers. The presentation was made by Admiral Sir Reginald Custance and Earl Brassey, who stated that 3000*l.* had been collected. The money is to be allotted to the foundation of a Research Scholarship Fund, the provision of a memorial medallion to be placed in the hall of the Institution of Civil Engineers, and a grant to Westminster Hospital. The memorial was accepted by

Mr. Alexander Ross, the president of the Institution of Civil Engineers, and now occupies a position on the right hand of the entrance hall. The medallion consists of a portrait of Sir William, carved in relief in white stone, with a warship visible in the distance. The carving is mounted on grey marble, and carries underneath it a tablet, on which are inscribed the words:—"Sir William Henry White, K.C.B., LL.D., D.Sc., F.R.S., President, 1903–1904, Director of Naval Construction, 1885–1902. A Tribute from the Shipbuilders of Many Nations." Above is a scroll bearing the motto, "Build Staunch, Build True."

NEWS of Sir Ernest Shackleton's latest attempt to rescue his comrades on Elephant Island is expected daily. Last week the small Chilean steamer *Yelcho* returned to Ushuaia, in Tierra del Fuego, after towing to a point 240 miles south of Cape Horn the schooner *Emma*, with the rescue party on board. The *Yelcho* was in a damaged condition, but that may be the result of heavy seas. The telegram makes no mention of ice, and the report that the weather was favourable when the *Yelcho* turned back has really no bearing on the prospects of approaching Elephant Island. As already announced, the *Discovery* will be dispatched by the British Admiralty in the event of the *Emma* failing. It will, of course, take the *Discovery* some sixty days to reach Elephant Island, but, whatever the condition of the pack may be, she is powerful enough to force her way through and reach the stranded men.

A MALARIA mosquito survey is being conducted, under the supervision of Prof. W. B. Herms and Mr. S. B. Freeborn, on behalf of the California State Board of Health and the University of California. So far endemic malaria has been found at a maximum height of 5500 ft., and the anopheline carriers have been located. It is estimated that three summers will be required to complete the survey of the State.

THE Ellen Richards Research prize of 200*l.* for the best thesis written by a woman embodying new observations and new conclusions based on independent laboratory research in biology (including psychology), chemistry, or physics is offered by the Naples Table Association for Promoting Laboratory Research by Women. Application forms are obtainable from Mrs. A. W. Mead, 283 Wayland Avenue, Providence, Rhode Island, U.S.A. The competing papers must reach the chairman of the committee before February 25, 1917.

WE regret to announce the death, on July 25, at the age of seventy-six, of Mr. Roland Trimen, F.R.S.

WE note with regret the death, on July 28, at the age of seventy-three, of Sir W. H. Power, K.C.B., F.R.S., from 1900 to 1908 principal medical officer of the Local Government Board.

THE death is announced, at the age of eighty years, of the anthropologist, Prof. Johannes Ranke, of the University of Munich.

IT is with great regret that we learn that Lieut. Harper has been killed in action. Edgar H. Harper, who was thirty-three years of age, was born at Dungannon, not far from Belfast. His university career was one of exceptional brilliancy. At Trinity College, Dublin, he won the McCullagh and Bishop Law's prizes, and was awarded a special prize in the junior fellowship examination. He also graduated with first-class honours in the Royal University of Ireland. About the year 1908 he was appointed assistant-lecturer in pure and applied mathematics in the University College of North Wales, and six years later he obtained the chair of mathematical physics at University College, Cork. Last year he took a commission in the South Staffordshire Regiment. During his tenure of office at Bangor Prof. Harper's talents were turned to good account in the important part that he played in developing the mathematical theory of aeroplane stability. Although this work was undertaken in collaboration, the numerous references to his name in Prof. Bryan's "Stability in Aviation" bear testimony to his powers as an original investigator, quite a number of the results stated in that work having been first discovered by him. It was Prof. Harper, for example, who first discovered the necessity of extending the theory of inherent stability to cases other than that of horizontal flight. One result was the discovery of serious theoretical limitations in the angle at which an aeroplane could be expected to rise in the air. In connection with the effect of a dihedral angle on lateral stability we are also indebted to Prof. Harper for a number of elegant geometrical and other artifices by which the use of cumbersome algebraic expressions is greatly reduced. He was also joint author with Mr. Ferguson of "Aerial Locomotion" in the series of "Cambridge Manuals of Science and Literature."

SECOND-LIEUT. F. W. CATON, who was killed in France on June 28, was a chemist of rare ability, though he had contributed little to the literature of the subject. His influence was chiefly through his lectures on chemical and botanical subjects, but he showed great promise in biochemical research, on which he was engaged when war broke out. In August, 1915, he was gazetted to a commission in the South Staffordshire Regiment, but it was felt that his chemical knowledge could be of greater service to his country, and he was transferred to the Royal Engineers in March last, and soon afterwards accompanied them to France. He had a brilliant academic career; he went to Oxford from Brighton Grammar School with a postmastership to Merton College, and took his degree with honours in 1906, afterwards taking the London B.Sc. with first class honours in chemistry. For two years he was at the Wellcome Chemical Research Laboratory, where his work was productive of good results. In 1910 he was appointed chemistry master at Taunton School, leaving there in 1912 to take up the appointment of lecturer and inspector under the Staffordshire Education Committee. His death at the early age of thirty-two is sincerely deplored by those who knew him, either as a man or as a scientific worker.

MALACOLOGISTS will learn with regret of the death, at the age of fifty, of Henri Fischer, the son of Paul Henri Fischer, the celebrated author of the "Manuel de Conchyliologie" (a translation and extension of S. P. Woodward's "Manual"). Henri was educated at the Ecole Normale Supérieure and became "Maître de Conférences" attached to the Sorbonne. Following in his father's footsteps, he took up the study of mollusca, but more especially from the morphological point of view. In his thesis, "Recherches sur la morphologie du foie des Gastéropodes," and in many other memoirs of his he paid special attention to the embryological development. Individually and in collaboration with other zoologists, he wrote numerous important papers on his chosen subject, besides contributing articles on the mollusca collected on the "Mission Pavie" (1904), on those obtained by Prince Albert of Monaco in his dredging expeditions (1906 and 1910), and on the Arctic mollusca procured by the Duke of Orleans in 1907 (1910), whilst with Prof. Jobin he described the Cephalopoda obtained on the scientific expeditions of the *Travailleur* and *Talisman* in 1880–1883 (1906). He was besides one of the editors of, and

a frequent contributor to, the *Journal de Conchyliologie,* from vol. xlii., 1894, to the date of his death.

WE have just learned that Dr. Francesco Bassani, professor of geology in the University of Naples, died at Capri on April 26 last. He was born near Vicenza on October 29, 1853, and graduated in the University of Padua. After studying vertebrate palæontology at Paris, Munich, and Vienna, he eventually became professor at Naples in 1887. He devoted himself especially to the study of fossil fishes, and published numerous important memoirs on the fossil fishes of Italy. With the aid of many devoted pupils he enriched the geological museum of the University of Naples until it became one of the greatest collections of fossils in Italy; and during the failing health of his latter years he never lacked willing helpers in the continuation of his researches. One of his most distinguished pupils, Prof. G. de Lorenzo, has contributed an appreciative notice of the professor, with a portrait and list of his writings, to the *Rendiconti* of the Royal Academy of Naples (May–June, 1916).

WE have received from Prof. A. Cushieri a copy of his oration delivered at the funeral of the late Mr. Napoleone Tagliaferro, who was for many years director of public instruction in Malta. Mr. Tagliaferro, who died in October, 1915, was a most active supporter of the scientific exploration of the Maltese Islands, and his loss is mourned by many friends in Britain as well as in his native land. He laboured much in making known the dolmens and other prehistoric monuments of Malta, and took part in many excavations of the caves which were inhabited by early man. He also helped to make the Valetta Museum worthy of the Maltese University.

IN a paper read before the Indian Section of the Royal Society of Arts on June 1 Prof. Wyndham Dunstan summarised the work which the Imperial Institute has done for India, more especially during the thirteen years in which the institute has been a Government establishment. The work may be classified under three heads. First, there has been organised for public exhibition a collection of articles representing important raw materials produced in the dependency, with illustrations of the chief industries, tabular information, and diagrams respecting Indian trade and commerce, and maps, pictures, and photographs of the cities and industries concerned. All important exhibits are provided with descriptive labels, which enable the visitor at once to gain general knowledge of the sources and uses of the materials shown; these include, for example, fibres, teas, silks, opium, lac, metals, and minerals. Secondly, valuable work has been done by the Scientific and Technical Research Department, including special investigations upon the constituents of Indian drugs, oils, foodstuffs, and minerals. These researches were carried out with the view of promoting the utilisation of Indian raw materials in British manufactures, and were often supplemented by technical trials on a commercial scale undertaken in conjunction with trade experts or manufacturers. Among examples mentioned in some detail are researches upon opium, podophyllum, aconite, henbane, and datura; tanning materials and leather; turpentine and rosin; Burma beans; various textile and other fibres; coals, and thorium minerals. Finally, there has been established a Technical Information Bureau, the functions of which are to collect, collate, and distribute published information respecting the production and industrial uses of raw materials. This branch has been increasingly patronised by merchants, manufacturers, and producers, and has gradually come to be recognised as a sort of general "clearing-house" for information of the character indicated. That there is room for India to contribute more largely in the future to the Empire's resources of raw materials is instanced by particulars given respecting cotton, copra, hides, beeswax, thymol, and potash supplies.

AN article of general interest has lately been published, in the *Lancet,* on some of the wounded in the battle of Jutland Bank. It gives great and well-deserved praise to Sir Almroth Wright's plan for the treatment of septic wounds, not by antiseptic dressings, but by continuous saline irrigation. The action of the saline fluid not only washes out the interstices of the wound, but promotes the outward flow of lymph, which carries out of the wound the causes of its infection. This method, founded on an immense amount of scientific research, has given admirable results in the war, and the national debt of gratitude to Sir Almroth Wright is larger than ever. But while we praise his work we must not be led into the folly of belitting that of Lister. To be able to prevent an accidental wound, already infected, from going septic—that was Lister's achievement in 1865, and the world's gratitude to him is everlasting. To be able to make, in the operations of surgery, a deep extensive wound, exposing freely any cavity of the body, and to know that the whole wound would heal rapidly and painlessly, from end to end, under a single dressing, left untouched until the wound was healed—that was Lister's achievement in the years after 1865. In the multitude of wounds there are thousands of opportunities for Wright's method, and there are thousands of opportunities for Lister's method, with those modifications which have since 1865 been found valuable. Nothing could be less logical, or less practical, than to represent these two methods as hopelessly at strife; each has its worth for the saving of limbs and lives.

MR. R. E. NICHOLAS, hon. curator of the Tudor House Museum, Southampton, has published a "Record of a Prehistoric Industry in Tabular Flint at Brambridge and Highfield, near Southampton" (Toogood and Sons, Southampton). He carefully describes the sites with explanatory diagrams, and devotes no fewer than forty-one plates to illustrations of the flints, which are photographed or drawn in a most effective manner. The modes of chipping of the specimens are remarkably varied, and in an appended note Dr. Robert Munro expresses the opinion that the industry represents the transition period between the Palæolithic and Neolithic civilisations. He compares the undoubtedly worked flints with those found at Cissbury, in the Oban caves, and in the shell mounds of Oronsay. Such discoveries appear to be rare along the south coast of England on account of its submergence in post-Glacial times.

THE great sea-serpent was observed on June 14 by a Swedish officer, Major O. Smith, in Lilla Värtan, a small tract of water not far from Stockholm, connected with the Baltic. "At 2.25 p.m.," he says, "we suddenly observed a movement on the water like a choppy swell, not more than 100 metres from us. Elsewhere the water surface was smooth, without boat or anything that could cause such a movement in the water. Observing more closely, we each of us saw a very distinct head, like a huge serpent head, somewhat elongate, larger than a man's head, and behind it a long, serpent-like body with a length of about 25 metres. One wave or hump followed the other, ten or more in number. Towards the hinder end a larger part of the body was raised above the water. For more than a minute we could observe this peculiar creature. It swam at a speed of about two knots. I have seen both porpoises and whales, and

can judge of the differences between the various movements in the water. This movement was like that of a serpent." A. F. Robbert writes to *Svenska Dagbladet* (June 21) that last year he observed a similar phenomenon due to sudden gusts of wind raising small regular billows which interfered with the reflection of the sun from the water and thus intensified the effect. Had he not been possessed of a scientific training and a critical spirit accustomed to observation, he would certainly have regarded the phenomenon as produced by a sea-serpent.

The Brooklyn Museum Science Bulletin, vol. iii., No. 4, is devoted to the description of the sharks of Long Island. The authors, Messrs. J. T. Nichols and R. C. Murphy, have brought together some valuable information on this theme, in regard to the life-histories of these fishes. In referring to the food of the blue shark, the "junior writer" remarks that captured blue sharks, as well as certain other species, have the power of everting the stomach, so that the whole organ, turned inside out, trails a foot or more from the mouth. Possibly, it is suggested, this denotes a habit of ejecting indigestible material such as most sharks frequently swallow. In regard to the strange hammer-head shark, he remarks that its food includes squids, barnacles, and crabs, as well as menhaden and other fishes. But on one occasion, from an eleven-foot specimen, many detached parts of a man, together with his clothing, were taken. Outlines of the several species described add materially to the value of this report.

Dr. James Ritchie's paper on a remarkable brackish-water hydroid (Rec. Ind. Mus., xi., part vi., No. 30) is well worth the attention of students of the Hydrozoa. The organism described, *Annulella gemmata* by name, comes from a brackish pond in Lower Bengal. It consists of solitary, naked polyps temporarily attached by an adherent basal bulb which is surrounded by perisarc embedded in a gelatinous secretion. The usual mode of reproduction is by asexually produced buds, which break away from the parent as minute planulæ. Dr. Nelson Annandale, who collected the hydroid and studied it alive, believes that he saw gonosomes borne in a circle round the hydranth and breaking away as free medusæ, but Dr. Ritchie finds no trace of such an arrangement in the preserved material.

In the Journ. Agric. Research (vi., No. 3) J. H. Merrill and A. L. Ford describe two nematode worms parasitic on insects. Both worms belong to the genus Diplogaster, the host of one being the longhorn beetle, *Saperda tridentata*, of the other *Leucotermes lucifugus*. The life-histories of the nematodes are described, and the termite-infecting species may be deadly to its host.

Under the title of "Staircase Farms of the Ancients," Mr. O. F. Cook, in the *National Geographic Magazine* for May, gives a striking account of the system of terrace cultivation and irrigation carried out in Peru during the Inca period. The writer, an accomplished botanist, remarks that, Peru being the home of the potato, it may be regarded as the source from which will be derived new stocks to maintain the varieties of this great food staple. Peru has many kinds of potatoes, superior in quality to the varieties now under cultivation in the United States, but most of them would not meet with approval, because the tubers would be difficult to peel on account of their irregular form and deep eyes. But with such an infinity of new forms to draw upon in South America, it should be possible by careful selection to combine all the desirable features. Peru offers a specially important field for economic botany, as many of the agricultural plants of this region are still entirely unknown in other countries.

"*Pinus longifolia*, a Sylvicultural Study," by R. S. Troup, is the latest issue in the series of Indian Forest Memoirs (Calcutta, 1916). This pine is one of the most useful trees in the Himalayas, where it forms at low altitudes extensive gregarious forests, which are accessible and easily worked, yielding a timber of fair quality. The tapping of the tree for resin and turpentine promises to develop into a considerable industry, and the revenue from this source in the Naini Tal division is now much greater than that derived from timber and fuel. The memoir is profusely illustrated, but lacks an index and also a map of the distribution of the forests of this valuable tree. The botanical account is elaborate, and errors in current text-books concerning the period of shedding of the leaves and the time required by the cones to ripen are corrected. This species is very liable to "twisted fibre," which renders useless a considerable percentage of the timber, as it cannot be sawn into planks. The cause of this phenomenon, which may be often observed in sweet chestnut growing near London, is obscure, but some evidence is adduced to show that it may be attributed to damage done during youth by fire or other injurious agency. Full information is given concerning the natural and artificial modes of regeneration and the best methods of management of forests of this pine, as well as of the ways by which danger from fire and grazing can be averted or lessened. Numerous tables relating to rate of growth and yield per acre are appended.

Dr. Erwin F. Smith, to whose researches we owe so much of our knowledge of plant diseases, has expounded his views on the parasitic nature of cancer in an address before the Washington Academy of Sciences (*Science*, June 23). With refreshing vigour he claims a close analogy between the malignant tumours of animals and the crown-gall of plants due to *Bact. tumefaciens*. Great weight is laid on the peculiar group of sarcomatous tumours of birds, discovered by Peyton Rous, and shown by the latter to be due to an ultra-microscopic virus, while the fact that the majority of bird tumours have not been reproduced in the same way is ignored. The paper on "Crown-Gall" in the *Journal of Cancer Research* (vol. i., No. 2, 1916) is a monument to Dr. Smith's industry, and gives a very complete picture of the varied effects of *B. tumefaciens* in a variety of plants. The results of animal inoculation with this organism are in no way comparable with tumour growth, a failure which does not greatly detract from the interest of the author's ingenious speculation.

Mr. R. Bullen Newton has contributed to the "Reports on the Collections made by the British Ornithologists' Union Expedition to Dutch New Guinea, 1910–13," an important description of some fossiliferous limestones from Mount Carstensz, with photographic illustrations of their microscopical structure. The limestones obtained from the snow-line at 14,200 ft. appear to be of Miocene age, and correspond with limestones already known from the Philippines, Formosa, Christmas Island, Sumatra, Borneo, Celebes, and Australia. They are filled with Foraminifera of the genera Lepidocyclina, Cycloclypeus, and Amphistegina, besides abundant Nullipores of the genus Lithothamnium. Pebbles from the bed of the Utakwa River seem to represent another much older limestone, perhaps of Lower Jurassic age. Fragments of lignite of uncertain origin also occur. Mr. Newton

has added to the value of his work by including an exhaustive bibliography of the geology of New Guinea.

THE water-power resources of the United States continue to be studied in detail by the Geological Survey, and several further reports have been published. Water-supply Paper 372 deals with a water-power reconnaissance in South-central Alaska, and shows that there is less water-power available in that region than had been supposed, and most of it is unavailable during the winter months. This latter objection could, of course, be overcome by adequate storage reservoirs, which are no doubt possible; but more accurate surveys are needed before this could be decided. The possible competition of water-power with coal power—for coal occurs in this region—raises important geographical questions, but is outside the scope of the inquiry. A second volume (No. 373) deals with the water resources of Hawaii, but, unfortunately, contains no discussion of results.

THE Geological Survey Report, No. 6 of the Department of Mines, Tasmania, "Reconnaissance of the North Heemskirk Tinfield," by L. L. Waterhouse (1915, pp. iv+74, 7 plates), describes the economic geology of the mining field, which is situated on a somewhat inaccessible part of the western coast of Tasmania. The oldest rocks are a series of slates, quartzites, and tuffs, which are regarded by Twelvetrees as Cambro-Ordovician, though there is no direct fossil evidence of their age. These rocks have been invaded by Devonian granites and gabbros, and by diabase which is assigned to the same age as the upper Mesozoic sill that is such a conspicuous feature in the central plateau of Tasmania. The only Cainozoic rocks consist of flows of basalt and beds of sandstone and conglomerate, some of which have been cemented into a hard quartzite, such as is often found associated with the Australian basalts. Associated with these rocks are ancient river deposits with tin-bearing gravels. Mr. Waterhouse shows that these are younger than the diabase and gabbro and older than the basalt; hence his geological study of the field helps the prospector by showing that it is no use boring through the older basic rocks in the hope of discovering under them a continuation of the tin-bearing gravels. The tin is primarily due to the Devonian granites, and quartz-tourmaline-cassiterite veins occur around it near Mount Heemskirk. Some primary ores of copper have been found, but also in too small quantities to be of economic value. Some extensive masses of magnetic iron ores occur beside the granite massif, but, owing to their inaccessible position, their tonnage is too small for present use. The value of the field depends upon its alluvial tin ores, which are worked by hydraulic sluicing. The report is illustrated by a useful geological sketch-map.

THE Memoir of the Geological Survey on the country around Milford (1916, price 2*s*. 6*d*.) is a further addition to the description of the South Wales coalfield, and includes a petrological account of the Ordovician volcanic rocks of Skomer Id. Dr. Thomas proposes two new names, Skomerite and Marloesite, for types of lava in which albite-oligoclase is associated with augite in a fine-grained ground. The marloesites contain glomeroporphyritic groups of olivine and albite. The map given indicates a remarkable variety of igneous types running in parallel bands across the island, and summarises the work already published by Dr. Thomas in 1911.

MR. S. TABER publishes in the *American Journal of Science*, vol. xli. (June, 1916), p. 532, a paper, based on experiments, on "The Growth of Crystals under External Pressure," which has a wide geological bearing. Previous workers have held contradictory views as to the reality of a crystallising force, which the author reconciles by showing that "a crystal surface will not grow under pressure and therefore will not do work in overcoming external forces resisting growth unless the surface is in contact with a supersaturated solution." He suggests that the outward pressure exerted by a growing concretion may cause the solution of material, which it gradually replaces. On the other hand, when a material has its solubility increased by pressure, there is a contraction of the total volume, and the separation of such a substance again from solution in a closed and limited space, as in the capillary passages of a shale, may develop enormous pressure. Is the author right, however, in stating that concretions in which the bedding planes are retained, and not thrust aside, are rare in shales?

THE report of the Chief Inspector of Mines in Mysore for the year 1914 has just been issued, and shows quite a flourishing state of affairs. The staple mining industry is, of course, gold mining, and the production for the year amounts to 562,617·56 ounces, being an increase of about 0·2 per cent. on the previous year. It is a very satisfactory feature of the report that this production was obtained with a considerably greater measure of safety so far as the workers are concerned; the death-rate in the gold mines was 2·28 per thousand, as against 4·38 in 1913, whilst the number of serious injuries also shows a marked decrease. A considerable proportion (27·9 per cent.) of the fatalities were due to the air-blasts that form such a marked characteristic of the Kolar gold mines. Much attention is being given to these air-blasts, which are due to the splitting off of masses of the country rock, which appears to be in a condition of excessive internal strain, and the methods recently adopted of closely stowing the stoped-out areas with waste rock appears to have been attended with decidedly beneficial results. Of the other mineral products, manganese ore is the most important, the output being given as 18,055 tons, as against 10,501 tons in 1913. Small quantities of chromite, magnesite, mica, asbestos, and corundum have also been produced, but none of these minerals are as yet being got in any important quantity.

THE Meteorological Service of Canada has introduced a change in its monthly record of observations, and the issue for January, 1916, which has recently been received, gives data in more extended detail than formerly. Under the directorship of Mr. R. F. Stupart the results published are of a high scientific value, and deal practically with every branch of meteorology. A detailed list is given of the stations used, which shows a very extensive and complete series of observations. Hourly observations of pressure, temperature, and humidity are given at selected stations, and there are detailed observations of rainfall, sunshine, and wind. The weather conditions during January, 1916, were far from normal, and it is mentioned that the result of the persistent far southerly course of the depressions tracked from the Pacific Ocean was a continuance of northerly winds and almost unprecedented cold in British Columbia and the Western Provinces. A map for the area under discussion, exhibiting the difference from average temperature, shows a deficiency of 20° F. over Yukon, and as much as 25° F. in British Columbia, whilst the eastern half of the Dominion experienced very mild weather with much rain. It will be remembered that over England, and generally on this side of the

Atlantic, the weather was abnormally warm in January.

THE rainfall maps of Australia for 1915, prepared by Mr. H. A. Hunt, Commonwealth meteorologist, have been published. A large map shows the distribution of rainfall for the year, and a number of smaller maps, printed on the back, give the rainfall for each month. The year was characterised by an unusual amount of rainfall in the western part of the continent, which in some parts was the heaviest on record. On the other hand, the drought conditions in Queensland were the most severe ever experienced in that State. There were great losses of stock, and the sugar crops in the east coastal districts, as well as many of the cereal crops on the downs, were everywhere a failure. In the southern wheat belt, however, the conditions of rainfall were all that could be desired. Accompanying these well-sustained rains another important factor was the exceptionally mild winter, with a June and July temperature for the continent about $2\frac{1}{2}°$ above the normal. Probably the wheatlands of Australia never before experienced such favourable conditions of temperature and rainfall, and the result was a record harvest. The comparison with the previous year was most marked, for 1914 was a year of drought in South Australia and the Riverina.

THE *Quarterly Review* for July contains an article by Dr. Charles Davison on the sound of big guns. The author has collected together those accounts of the propagation of the sounds of big guns to great distances which are sufficiently numerous and well-authenticated to provide a basis for generalisations on the subject. The firing at Waterloo appears to have been heard in Kent, 140 miles away, and that when the *Alabama* was sunk by the *Kearsarge* in 1864, 125 miles away. The guns fired at the Naval Review in 1897 were heard 135 miles away, and the minute-guns fired at the funeral of Queen Victoria in 1901, 130 miles away. In all cases the audibility was greatest down the wind, owing, as Sir George Stokes showed sixty years ago, to the bending of the sound-waves downward by the greater speed of the wind as the height above the ground increases. The remarkable zones of silence which sometimes intervene between stations near the guns and the more distant points at which the sounds are heard are equally well explained by the existence of local winds blowing towards the source of sound and tilting up the sound-wave above the heads of the listeners. The author makes no reference to the approximate equality of the maximum distances a century ago and now when the guns are much larger, although this requires explanation.

AT the present time, when the production of glass apparatus for scientific and technical purposes is receiving special notice in this country, attention may be directed to Circular No. 9 of the United States Bureau of Standards, which deals with the testing of glass volumetric apparatus. It is drawn up, no doubt, with a view to American requirements, but the principles involved are of general application. For the assistance of manufacturers specifications are given respecting the construction of glass instruments, such as measuring flasks, cylinders, pipettes, burettes, specific gravity bottles, and "Babcock" bottles for milk analysis. The information indicates the requirements of the Bureau as to the dimensions, designs, and types of vessels which are suitable for standardisation, and describes how the graduation of them should be carried out, with the limits of error which are tolerated in the calibration. Useful hints may be gathered from the circular by manufacturers who are taking up the industry in question.

OUR ASTRONOMICAL COLUMN.

MONOCHROMATIC PHOTOGRAPHS OF PLANETS.—Prof. R. W. Wood has given an account of further results obtained by the photography of celestial bodies through filters transmitting limited regions of the spectrum (*Astrophysical Journal*, vol xliii., p. 310). After much preliminary work, successful photographs were readily obtained when the 60-in. reflector at Mount Wilson was placed at his disposal for four nights during last October. For the ultra-violet filter a bromine cell was used, transmitting the region from 3500 to the end of the solar spectrum at 2900; the infra-red screen transmitted the region above 7000, the yellow screen all rays above 5000, and the violet from 4000 to 4500. In the case of Saturn the pictures taken through the infra-red screen only showed the merest traces of the belts ordinarily seen, while through the yellow screen the planet presented its usual appearance. On the plates taken with violet light a very broad, dark belt surrounded the planet's equator, and a dark cap of considerable size was shown about the pole. These features were also present in ultra-violet light, but were less pronounced; they may possibly be due to the existence in the planet's atmosphere of some substance capable of absorbing violet and ultra-violet light. Another point of interest was a decrease in contrast between the inner and outer ring as the wave-length of the effective light decreased, suggesting that the outer ring contains so much finely divided matter that it shines in part by diffusion. In the case of Jupiter, the dark belts were scarcely visible on the infra-red plates, while they were shown in greatest contrast with violet light. The dark polar cap shaded off gradually in the yellow and infra-red pictures, but was sharply terminated in the violet and ultra-violet photographs. It is hoped that it may be possible to investigate the surface of Mars by this method at the next near approach to the earth.

THE POLAR CAPS OF MARS AND SOLAR RADIATION.—An interesting investigation of the rate of melting of the polar caps of Mars in relation to the sun-spot period has been made by M. Antoniadi. An examination of the records of the planet from 1862 to 1914 has shown that, in general, the polar caps melt more rapidly at times of great solar activity than when solar activity is feeble. Out of twenty-one series of observations during the period in question, no fewer than seventeen were definitely in favour of this conclusion, and only four unfavourable. Two of the exceptions were the oppositions of 1862 and 1873, when the melting of the caps was normal, in spite of considerable solar activity; another was in 1877, when rapid melting occurred with feeble solar activity; and the fourth in 1886, when rapid melting was associated with only moderate solar activity. The slowest recorded shrinkage of the caps accompanied the prolonged sun-spot minimum of three years ago, while one of the most rapid rates of melting coincided with great spot activity in 1894. M. Antoniadi's conclusion is in satisfactory agreement with the now generally accepted view that solar radiation is greatest at times of sun-spot maximum, and with the supposition that the polar caps of Mars are very thin, and consequently very sensitive to variations of temperature (Royal Astronomical Society, June).

VARIABLE STARS NEAR THE SOUTH POLE.—In continuation of the search for variables on photographs covering the entire sky, Miss Leavitt has examined plates of the stars near the South Pole, and has discovered nineteen new variables in that region. One of them is apparently of the Algol type, having a normal magnitude 10 and a minimum of 10·6 (Harvard Circular 191).

THE IPSWICH CONFERENCE OF THE MUSEUMS ASSOCIATION.

THE twenty-seventh annual conference of the Museums Association was held in Ipswich on July 10–12, when the following institutions were represented by delegates:—(1) Five national museums—the British Museum, the British Museum (Natural History), the Victoria and Albert Museum, the National Museum of Wales, and the Museums of the Royal Botanic Gardens at Kew; (2) two London museums—the Horniman Museum and the Wellcome Historical Medical Museum; (3) the following twenty-five provincial museums and art galleries—Brighton, Bristol, Carlisle, Chelmsford, Derby, Dundee, Exeter, Halifax, Hastings, Hull, Ipswich, Leicester, Lincoln, Liverpool, Merthyr Tydfil, Newbury, Norwich, Perth, Peterborough, Plymouth, Reading, Salford, Warrington, Worcester, and Worthing; and (4) the Museum of the University of Manchester.

After a hearty welcome by the Mayor of Ipswich, the president, Mr. E. Rimbault Dibdin, curator of the Walker Art Gallery, Liverpool, addressed the delegates, taking as his subject the effect of the war upon the art museums of the country. He had sent a series of questions to eighty-two art museums in Great Britain, and from their answers was able to give some interesting details as to their experiences. Briefly summarised, his remarks indicated that whereas several London galleries have been closed by the action of the Government, and one or two others report a reduced attendance, the majority of the provincial institutions show an increased attendance, and only one has been closed. It thus appears that the protest lodged with the Prime Minister by the Museums Association against the Government Retrenchment Committee's suggestion that provincial museums and art galleries should be closed has been thoroughly justified.

Mr. F. Woolnough read a paper on "The Future of Provincial Museums," in which he said the question was chiefly one of finance, and pleaded for the removal of the restrictions which either make museums dependent upon a share of the library rate for their income or limit them to the Museums and Gymnasiums Act halfpenny.

Some remarkable specimens were shown by Mr. F. R. Rowley in illustration of his comments on the use of arsenious jelly as a preservative. This method was described by S. Delépine in the *Museums Journal* for April, 1914, p. 322. Mr. Rowley has made some slight modifications, which will form the subject of a note in the journal. Among the specimens shown were a viper, newts, crustacea, and marine algæ. The latter were beautifully preserved, both as to colour and form, and all had the advantage of being embedded in a clear, solid mass, which could be laid flat.

"The Educative Value in Public Museums of Introductory Cases to Animal Groups" was introduced by Dr. J. A. Clubb, who advocated the primary importance of comparative morphology, as against mere classification, for the inspiration and enlightenment of the ordinary visitor. How to get hold of those who come to the museum with no previous knowledge of, or particular interest in, its subjects is an urgent problem, to which Dr. Clubb and many other thinking curators are addressing themselves.

Mr. R. A. Smith, of the British Museum, announced that certain duplicates of prehistoric implements were available for distribution to provincial museums.

The claims of the British Science Guild were brought forward by Mr. E. E. Lowe, who spoke of the Guild as an association with magnificent and comprehensive aims which should claim the allegiance of every person interested in the national utilisation and recognition of scientific work and workers.

Many communities are now organising photographic surveys of their own districts in order that accurate historical and scientific records may be handed down to posterity, and Dr. A. H. Millar's paper on the "Photographic Survey of Dundee" was particularly opportune.

Mr. F. Woolnough, the curator of the Ipswich Museum, gave demonstrations (*a*) upon a case for exhibiting postage stamps, and (*b*) upon the "Fothergill" and hot-sand methods of drying flowering plants in their natural colours. Many of the plants dried by the "Fothergill" process showed remarkably successful results. A useful demonstration was given by Mr. W. K. Spencer on the use of gelatine moulds for plaster casts. He showed that where an object was much "undercut" the flexibility of gelatine gave it many advantages over plaster.

To the business meeting the hon. secretary (Mr. E. E. Lowe) reported as to his efforts to get rectangular glass exhibition jars made in England. Many manufacturers had been interviewed, but none were able to tackle the work in the midst of present labour and other difficulties. There is little doubt, however, that the manufacture will be embarked upon within the next year or so, thus rendering museums, hospitals, and medical schools independent of the German supply. The secretary can offer an immediate order for 250*l.* worth to anyone who will undertake to produce rectangular jars of a good quality at a reasonable price, and he has evidence of a large annual demand.

RECENT ZOOLOGICAL RESEARCH IN SOUTH AFRICA.[1]

THE "Annals of the Natal Museum," although only yet in its third volume of publication, has justly earned repute for the quality of the researches published therein. The journal is well printed and admirably illustrated with lithographic and other plates. In its current issue we have a bulky record of original investigations covering a wide field in the rich fauna of South Africa. Mr. Hugh Watson contributes an important and very fully illustrated memoir on the carnivorous slugs, with particular reference to the genus Apera. This genus appears to be confined to the maritime provinces of South Africa, one species occurring on the slopes of Table Mountain, and the remainder in Natal and the eastern part of the Cape Provinces. In addition to a systematic revision of its species, the author gives a valuable account of the anatomy of the genus and a full discussion of its phylogeny. He concludes that the species of Apera have not been directly evolved from any herbivorous form, and in their anatomy and geographical distribution are more closely related to the Rhytidæ than to any other group. The only other carnivorous slug found in South Africa is the English *Testacella maugei*, Fér, which has a very wide distribution, and has probably been introduced into South Africa through the agency of man.

Mr. Claude Fuller, of the Division of Entomology, Pretoria, writes on South African Termites, and in a paper of more than 170 pages records a good deal that is new and interesting concerning the biology of these insects. Termites appear to be irregularly distributed in the Union, being rare in the South-West Cape, while in Natal and the Transvaal the soil is riddled from end to end of the country with their

[1] "Annals of the Natal Museum." Edited by Dr. Ernest Warren, director. Vol. iii., part ii., October, 1915. Pp. 107–504 and plates vii–xxxv. Price 15*s.* net.

tunnellings. Mr. Fuller describes his observations upon the behaviour of the winged sexual forms belonging to six different species. He shows that the belief that the aerial migration has for its object the prevention of interbreeding is not necessarily true, since the flights frequently comprise individuals of both sexes which readily pair. This same feature has also been observed by the reviewer in the case of a Himalayan Termite. Intercrossing occurs at times among individuals of different nests, but Mr. Fuller concludes that the real object of the production of sexual forms in such vast numbers is in order to perpetuate the species, which suffers immense mortality during the annual exodus. Some sixty-four pages are devoted to observations on the nest-building habits and general economy of thirteen species of Termites, and details of the various types of nests are well illustrated on the accompanying plates. The remainder of the paper comprises a systematic account of species, chiefly belonging to the genera Hodotermes, Termes, and Eutermes. The characters of the soldiers and workers are well described, but unfortunately no accounts of the winged forms are included, and it is to be hoped that the author will make these the subject of a further memoir.

Mr. J. Hewitt contributes a paper on South African Arachnida, mostly based on specimens in the Albany Museum. Altogether three genera, eleven species, and one variety are recorded as new, and the most interesting feature brought to light is the discovery of two new genera of marine spiders taken near Cape Town. The remainder of the journal is occupied by two short papers by Dr. Warren, one dealing with the tendency of the Saturniid moth, *Melanocera menippe*, Westw., to exhibit parthenogenesis, and the other with an extension of his previous observations upon hybrid cockatoos.

A. D. IMMS.

THE CROYDON NATURAL HISTORY SOCIETY.

THE Transactions of the Croydon Natural History and Scientific Society for 1915, a copy of which has just reached us, contain a particularly good paper by Mr. G. M. Davies on the rocks and minerals of the Croydon regional survey area. The paper runs to 44 pages, and includes a careful series of analyses of rock-specimens from the Weald Clay and all the more recent formations. Reference is made to the discovery of the Marsupites-zone of the chalk at Russell Hill, Purley, and to the decomposition of marcasite, which gives rise to the soft masses of hydrated iron oxide ("red ochre") so frequent in the chalk. A few sarsens are noted as occurring in the neighbourhood. Granules and grains of zinc-blende and galena are noted as occurring in fuller's-earth at Redhill and Nutfield. The number of minerals found in residues is somewhat surprising, and a complete list is given. The regional survey, under the direction of Mr. C. C. Fagg, shows satisfactory progress, and in connection with it Baldwin Latham has prepared a map showing the site of the five Bournes which flow in the area.

Mr. William Whitaker describes an extraordinary outlier of Blackheath pebble-beds at Tandridge Hill. With the pebbles are patches of fairly large unworn flints, resembling in shape flints as found in chalk-pits. Flints in any intermediate stage of weathering are not found, and the two cannot have been produced by the same agency. It is thought that, during or after the deposition of the rounded Blackheath beds, the unworn flints have been quietly removed from the chalk during the dissolution of the latter, and left near to their original position. The extension of the outlier so far south is of interest, but especially is it so in that though the uppermost outlier is nearly 800 ft. O.D., the lowest extension is 200 ft. lower, on the face of the escarpment of the chalk. Hence we here find Eocene beds resting on lower chalk, an occurrence unknown elsewhere. The conclusion come to is that long-continued solution of pebble-covered chalk took place on a large scale, and the pebble-beds were very gradually let down. There was no evidence of faulting. It is fairly certain they could not have been originally deposited on the middle and lower chalk as now found.

The usual valuable meteorological statistics for 1915, compiled by Mr. F. Campbell-Bayard, with rainfall day by day from 104 stations, is of value to water-economists. In a paper summarising the fossil records of *Ginkgo biloba* and its ancestors, Mr. E. A. Martin remarks that there has been of late a considerable increase of small specimens of this tree in this country. Hitherto this "living fossil," as Seward calls it, has been represented chiefly by male trees, and it is hoped a balance may be restored now that it is included in florists' catalogues.

THE LAKE VILLAGERS OF GLASTONBURY.[1]

THE Lake Village of Glastonbury consisted of between eighty and ninety round huts surrounded by a stockade, and planted for security at the edge of the sheet of water, that is now represented by the peat in the marshes, extending from Glastonbury westward to the sea. The inhabitants smelted iron and made various edged tools and weapons—axes, adzes, gouges, saws, sickles, bill-hooks, daggers, swords, spears, etc. They also smelted lead ore from the Mendip Hills, and made net-sinkers and spindle-whorls. They probably carried on the manufacture of glass beads and rings and other personal ornaments. They were also workers in tin and bronze. It is likely that the beautiful Glastonbury bowl was made in the settlement, since unused rivets of the same type as those of the bowl have been commonly met with. They were expert spinners and weavers, carpenters and potters, using the lathe in both industries. The discovery of a wooden wheel, with beautifully turned spokes, proves that they possessed wheeled vehicles, while the snaffle-bits of iron imply the use of the horse. Their commerce was carried on partly by land, and the possession of canoes gave them the use of the waterways. They were linked with other settlements by the road running due east from Glastonbury, that formed a part of the network of roads traversing the country in the prehistoric Iron age, more especially with the lead mines and the fortified oppida, or camps, of Mendip and of the rest of the county. They were also linked with the Bristol Channel by a waterway along the line of the river Brue, and along this was free communication with the oppidum of Worlebury, then inhabited by men of their race.

The lake villagers were undoubtedly in touch with their neighbours by sea and by land. Their jet probably came from Yorkshire; their Kimmeridge shale from Dorset; the amber from the eastern counties, or from the amber coast south of the Baltic. The cocks for fighting were probably obtained from Gaul, and the oblong dice are identical with those used in Italy in Roman times. Some of the designs on their pottery are from the south, and the bronze mirrors are probably of Italo-Greek origin. The technique of the

[1] Abridged from a paper read before the Literary and Philosophical Society of Manchester on April 18 by Hon. Prof. W. Boyd Dawkins, F.R.S.

Glastonbury bowl is that of the goldsmiths of Mykenæ. The whole evidence points to a wide intercourse with the other British tribes, as well as to a commerce with those of the Continent, extending so far south as the highly civilised peoples of the Mediterranean. It falls in line with that offered by other discoveries recorded in other parts of Britain, in settlements and tombs, by General Pitt-Rivers, Sir Arthur J. Evans, and others, proving that the inhabitants of Britain were highly civilised, and were not isolated from the high Mediterranean culture for some two hundred years before the Roman conquest.

We may infer from the absence of Roman remains that the lake village was abandoned before the influence of Rome was felt in Somerset. All doubt, however, as to this point is removed by the recent explorations of Wookey Hole Cavern, where the group of objects in the lake villages was found in five well-defined layers underneath two superficial strata of Roman age, the latter being dated by the coins, ranging from the time of Vespasian (A.D. 69–79) to Valentinian II. (A.D. 375–392). Here we have proof that the civilisation of the prehistoric Iron age was pre-Roman, and that it ended in Somerset with the Roman conquest. It has been traced in other parts of Britain so far back as 150 to 200 B.C.

The lake villagers were of pure Iberic stock, without admixture with other races. They belong to the small aborigines in Britain in the Neolithic age, characterised by long or oval heads, who were conquered in the Bronze age by the invading Goidels, and in the prehistoric Iron age by the invading Brythons, both of whom have left their mark in the topography of the district, by river names, such as the Axe (Goidelic) and the Avon (Brythonic for water), and hill names, such as Dundry dun (Goid) = fort, Mendips Maen (Bryth) = stone, Pen (Bryth) = hill. From these it may be concluded that the language spoken by the lake villagers was closely allied to the Welsh. They were closely related to the Silures, the ruling tribe in South Wales at the time of the Roman conquest.

The village was sacked, and, as the skulls exhibited show, the inhabitants had been massacred, probably during the conquest of that region by the Belgic tribes, whose further progress was arrested by the Romans. This remarkable discovery is being followed up by the examination of another lake village at Meare, on the same waterway, and belonging to the same pre-Roman age. The first volume was published in 1911, and the second is now nearly completed. When the whole story is told, by Bulleid and Gray and the other contributors to "The Lake Village of Glastonbury," it will fill a blank in the prehistory of Britain, and form a sound basis for history.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. T. E. GORDON has been appointed professor of surgery in Trinity College, Dublin, in succession to Prof. E. H. Taylor.

THE Astley Cooper prize for the present year, for a treatise on "The Physiology and Pathology of the Pituitary Body," has been awarded to Dr. W. Blair Bell, of Liverpool.

DR. T. G. MOORHEAD (Captain, R.A.M.C.) has been elected professor of the practice of medicine in the school of the Royal College of Surgeons in Ireland, in the place of Sir John Moore, retired.

EFFORTS are being made by the Kansas State Board to get the State universities to co-operate in an endeavour to induce the Government to establish a health experiment and research laboratory in connection with each university school of medicine under the U.S. Public Health Service.

THE Board of Education has recently issued an interesting Memorandum on the teaching of coal-mining in part-time schools (Circular 953; price 4*d*.), upon lines which constitute a departure to some extent from the methods of teaching coal-mining students that have hitherto obtained, in that they definitely recognise the principle already tacitly admitted by some of the most experienced teachers of mining, namely, that the subject in which coal-mining students least need instruction is that of coal-mining. The coal-mining communities may to-day claim to rank amongst the most intelligent of our working classes, a condition of things due largely to the fact that a man is required to pass a written examination before he can enter the ranks of the higher colliery officials. All British coalfields have accordingly arranged some system of mining tuition, and the object of the present Memorandum is to co-ordinate these, and to base the methods of instruction upon sound principles. The insistence upon a scientific training as the basis of all mining education is a welcome feature of this Memorandum, and there can be no doubt that its general adoption will prove useful. It is perhaps legitimate to regret that its wording is in places open to misconstruction; thus the expression "practical mathematics" is here used in the sense of elementary mathematics applied to practical purposes, instead of in its generally adopted sense; again, it is a pity that the term "mining science" is repeatedly used when the real meaning is science applied to mining. The main point, however, is that the Board of Education has now issued a definite scheme in which a systematic and progressive education in scientific principles is recognised as the correct method of training coal-mining students.

THE report of the Board of Education for the year 1914–15 (Cd. 8274) is now available. The period dealt with coincides almost exactly with the first year of the European war, and the report is consequently concerned largely with the dislocations and modifications in the educational services brought about by the conflict. For reasons of economy the Board has suspended the great bulk of its statistical work, and many of the illuminating tabular statements of previous years are wanting. The report not unnaturally emphasises the need for economy in the administration of the public services; but we notice with satisfaction the admission:—"We desire, however, to record our conviction that the claim to regard reductions of expenditure on the public service of education as true economies requires, in the case of every item, the most careful scrutiny." All grades of education are dealt with fully in the report, but it is possible here to refer to one or two points only. The demand for munitions of war has had two effects upon technical schools: first, many schools have been engaged in actual munition work, and, secondly, many schools have inaugurated experimental courses for the training of unskilled persons for the purpose. As to the number of students in attendance at continuation and technical schools in England, the report states that the number of evening and other part-time schools recognised by the Board for 1913–14 was 6269, and the number of individual students under instruction at any time during the year in these schools was 726,626. In the same year twenty-seven institutions providing instruction courses were recognised, the total number of such courses in them being seventy-eight. The number of institutions in which day technical classes were recognised in

1913–14 was eighty-nine; the corresponding number for 1912–13 was 110, but this included institutions providing courses which in 1913–14 became junior technical schools. Up to and including 1914–15 there were forty-nine recognised junior technical schools, thirty-seven for boys and twelve for girls. The report contains also a survey of the influence of the war upon the work of universities and university colleges assisted by Treasury grants.

SCIENCE as "Cinderella" is the subject of an informing and suggestive article in a recent issue of the *Glasgow Herald,* and of a subsequent trenchant letter in the same journal by Prof. Soddy, F.R.S., which deals with the manner in which a certain large endowment intended for the promotion of scientific study and research is, and has been, diverted largely to other purposes of an entirely general educational character, which, however desirable to promote, were not the objects Mr. Carnegie had directly in view when making his generous gift of 1,000,000*l.* sterling in aid of the extension of the means of scientific investigation in the Universities of Scotland. It was perhaps too much to expect that a body of trustees, upon which there was, and is, only a very limited representation of men of distinction who were, or had been, actively engaged in scientific research, should regard that object as its first duty, but it is startling to learn how inadequately the interests of science have been served in the disposal of the income derived from the trust. The truth is that there is a lamentable lack of vital and intelligent interest in the sphere of science as an essential factor in the education of the nation, and as an indispensable instrument of its civilised progress. It is only by a thorough understanding of the phenomena of Nature and of man in all his activities and aspects, and through a firm grasp of the knowledge so gained, that humanity can rise to higher levels of well-being. The unfortunate attitude of the governing classes of the nation towards science is, as has been well said, largely "the result of the monastic traditions of the great public schools and universities in which most of our leading politicians have been trained." We need a genuine endowment of research, which shall have for its sole purpose the personal encouragement and support of the most gifted men of the time, who will give their whole energies to the pursuit of knowledge, assisted by men of proved competence. The teaching and training of the capable youth of the nation may well be left to the many able expounders of scientific theory and practice now available, who would draw their inspiration from the work of such men as are here indicated. We seek at this supreme crisis of our national history a man of clear vision and firm purpose who, taking all branches of knowledge for his province, will assign to each its true place and function in the education and training of all classes of the people. Such a man and such a purpose have yet to be achieved.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, June 30.—Prof. C. V. Boys, president, in the chair.—Dr. P. E. **Shaw** and C. **Hayes**: A sensitive magnetometer. A torsion balance of extreme delicacy carries a pair of purest silver balls, each 3 gm. weight. A solenoid, with horizontal axis passing through one of the silver balls, is brought close to the balance. On exciting the solenoid, divergent fields of known strength are obtained in the region of the ball. The resulting attraction of the ball to the solenoid is shown by a mirror reflecting a distant scale to a telescope. The couple on the torsion beam required to produce 1 mm. scale deflection is $4{\cdot}5\times10^{-7}$ dyne cm., and this torsion balance is 10^6 times as sensitive as any known to have been used previously in this kind of work. The results of these experiments are:—(1) The magnetic properties of the silver are ascertained even for weak fields of 1–10 gauss. (2) The silver has a pronounced retentivity, this effect being presumably due to the small trace of iron impurity. (3) The relation of susceptibility of the silver to the field used is found. The susceptibility of each of the constituent materials, (*a*) pure silver, (*b*) residual pure iron, appears to be greatly modified by the presence of the other material.—Dr. H. S. **Allen**: The latent heat of fusion of a metal, and the quantum-theory. A criticism is given of a theory of the process of fusion recently put forward by Ratnowsky. The author of the theory obtains an expression on certain assumptions for the entropy of a substance in the solid state. He then proceeds to deduce a simple formula suitable for use at high temperatures. It is shown that this formula is incorrect in consequence of the omission of a term in the expansion.—Prof. H. **Chatley**: Cohesion (part ii.).

MANCHESTER.

Literary and Philosophical Society, May 9.—Prof. W. W. Haldane Gee, vice-president, in the chair.—Dr. E. **Newbery**: The theory of over-voltage. The author gave an account of the history and reasons for the study of over-voltage. The following points were discussed:—(1) Methods of measuring over-voltage, including the direct potential difference method, the "knickpunkt" method, the bubble-angle method, the oscillograph method, and the rotating commutator method. (2) The most important phenomena connected with, and controlling factors of, over-voltage. (3) The chief theories put forward to account for over-voltage. (4) The following theory was suggested—over-voltage of an electrode is determined by four factors:—(*a*) Supersaturation of the electrode surface with non-electrified gas under very high pressure, due to the permeability of the metal to the ionised gas, but non-permeability to the molecular and also to the spontaneous decomposition of the alloys containing the same gas. (*b*) Formation of a series of alloys or solid solutions of gas (or compound of gas and electrode substance) with the electrode surface. (*c*) Deficiency or excess of non-hydrated ions, charged and discharged, in the immediate neighbourhood of the electrodes. (*d*) Inductive action of the escaping ionised gas on the electrode.—R. F. **Gwyther**: The specification of stress. Part iv. (continued). The paper contains the stress relations for the most usual co-ordinate systems which were previously withheld. The method originally used to obtain the equations is retained, as the fact of the elimination of the displacement is of importance. The stress relations are consequently not limited in their application to specifically elastic stresses; they apply with equal effect to stress having only the general character of elastic stresses.

PARIS.

Academy of Sciences, July 10.—M. Camille Jordan in the chair.—E. **Perrier**: Remarks on the book, "Les Allemands et la Science."—M. Gonessiat was elected a correspondant for the section of astronomy in the place of the late G. H. Hill; M. Walden a correspondant in the section of chemistry in the place of Emil Fischer; M. Bataillon a correspondant for the section of anatomy and zoology in the place of the late J. H. Fabre; and M. Depage a correspondant for the section of medicine and surgery in the place of the late Guido Bacelli.—M. **Akimoff**: The transcendants of

Fourier-Bessel with several variables.—F. **Arago**: Contribution to the experimental study of waves.—M. **Dussaud**: New experiments on the separation of the luminous and calorific effects of a source of light. The two lenses forming the optical system are separated in such a manner that air can be circulated between them. The heat effects are thus reduced to a negligible quantity.—G. K. **Burgess** and H. **Scott**: The thermo-electric measurement of the critical points of iron. By the method described, which is a modification of that used by MM. Boudouard and Le Chatelier, both the A_2 and A_3 points are clearly shown by pure iron (99·968 per cent. iron).—J. M. **Lahy**: The psycho-physiology of the machine-gunner.—L. **Roule**: The migration of the tunny fish (*Orcynus thynnus*).—C. **Nicolle**: An attempt at preventive inoculation in exanthematic typhus.

July 17.—M. Ed. Perrier in the chair.—The president announced the death of Elias Metchnikoff, foreign associate, and gave an account of his life-work.—G. **Bigourdan**: The renaissance of astronomy at Paris, starting from the sixteenth century.—A. **Colson**: Demonstration of the rational character of the new solubility formulæ.—E. **Bourquelot** and A. **Aubry**: The biochemical synthesis of a galactobiose. The synthesis was effected by the action of emulsin upon an aqueous solution of galactose. Although the product could not be obtained in the crystallised state, it is shown that a galactobiose is formed.—E. **Teodoresco**: The presence of a phycoerythrin in *Nostoc commune*.—J. **Pavillard**: Some new flagellæ, epiphytes of the pelagic diatoms.—G. **Bourguignon**: A method of determining chronaxy in man with the aid of condenser discharges. Classification of the muscles of the superior member by the chronaxy according to their radicular origins.—J. **Delphy**: Abdominal scoliosis in *Mugil auratus* and the presence of a parasitic myxosporidia in this fish.

BOOKS RECEIVED.

The Chemistry of the Garden. By H. H. Cousins. Revised edition. Pp. xviii+143. (London: Macmillan and Co., Ltd.) 1*s*.

Economical Dishes for Wartime. By F. A. George. Pp. 48. (Birmingham: Cornish Bros., Ltd.) 6*d*.

Memoirs of the Connecticut Academy of Arts and Sciences. Vol. v. The Collection of Osteological Material from Machu Picchu. By G. F. Eaton. Pp. 96+plates xxxix. (New Haven, Conn.)

Cours de Manipulations de Chimie Physique et d'Electrochimie. By M. Centnerszwer. Pp. vii+180. (Paris: Gauthier-Villars et Cie.) 6 francs.

Exercices et Leçons de Mécanique Analytique. By R. de Montessus. Pp. ii+334. (Paris: Gauthier-Villars et Cie.) 12 francs.

The Birds of Britain: their Distribution and Habits. By A. H. Evans. Pp. xii+275. (Cambridge: At the University Press.) 4*s*. net.

A Shilling Arithmetic. By J. W. Robertson. Pp. viii+191. (London: G. Bell and Sons, Ltd.) 1*s*.

Revision Papers in Arithmetic. By C. Pendlebury. Pp. xv+68+xviii. (London: G. Bell and Sons, Ltd.) 1*s*.

Department of Mines. Memoirs of the Geological Survey of New South Wales. Ethnological Series. No. 2: i., The Cylindro-Conical and Cornute Stone Implements of Western New South Wales and their Significance. ii., The Warrigal, or "Dingo," Introduced or Indigenous? By R. Etheridge, jun. Pp. vii+53+plates xii. (Sydney: W. A. Gullick.) 7*s*. 6*d*.

Les Allemands et la Science. By Prof. G. Petit and M. Leudet. Pp. xx+375. (Paris: F. Alcan.) 3.50 francs.

Fungoid and Insect Pests of the Farm. By F. R. Petherbridge. Pp. vii+174. (Cambridge: At the University Press.) 4*s*. net.

A Treatise on the Theory of Alternating Currents. By Dr. A. Russell. Vol. ii. Second edition. Pp. xiv+566. (Cambridge: At the University Press.) 15*s*. net.

Combinatory Analysis. By Major P. A. MacMahon. Vol. ii. Pp. xix+340. (Cambridge: At the University Press.) 18*s*. net.

A Bibliography of British Ornithology. By W. H. Mullens and H. K. Swann. Part ii. (London: Macmillan and Co., Ltd.) 6*s*. net.

Hyperacoustics. By J. L. Dunk. Division I. Simultaneous Tonality. Pp. vi+311. (London: J. M. Dent and Sons, Ltd.) 7*s*. 6*d*. net.

The Danish Ingolf-Expedition. Vol. iii., Nos. 3 and 5. Crustacea Malacostraca. By H. J Hansen. Pp. 145+12 plates+1 chart, and a list of the stations, and pp. 259+16 plates+1 chart, and a list of the stations. (Copenhagen: Bianco Luno.)

A Treatise on the Circle and the Sphere. By Dr. J. L. Coolidge. Pp. 602. (Oxford: At the Clarendon Press.) 21*s*. net.

Fermat's Last Theorem. By M. Cashmore. Pp. 63. (London: G. Bell and Sons, Ltd.) 2*s*. net.

City and Guilds of London Institute. Department of Technology. Programme for the Session 1916–17. Pp. viii+408. (London: John Murray.) 9*d*. net.

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THURSDAY, AUGUST 10, 1916.

THE HISTORY OF THE FAMILY.

The History of the Family as a Social and Educational Institution. By Prof. W. Goodsell. Pp. xiv+588 pp. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

IN what sense is it right to speak of the history of the family? As an institution it occupies so central a position in the social structure that it may well seem fundamental. Should we write a history of stellar motion so long as the component forces determining it are constant? Are the forces which find expression in the family constant? Can it be said to have a history? The institutions surrounding the family vary from one age to another, and from people to people. Marriage ceremonials, customs in such matters as dowries, settlements, and other marriage contracts, are not uniform. The rights of parents over their children, of husbands over their wives, differ in a similar way. But can these differences be brought into any general historical scheme, or are they local variations brought about by economic and ideal forces acting upon an institution the essential nature of which has never altered?

Some such questions as these arise in one's mind as one takes up Prof. Goodsell's book, which is, however, rather descriptive in its treatment than historical. True, he has adopted a chronological order. After a very brief discussion of the primitive family he describes the matrimonial institution and family life of Hebrews, Greeks, and Romans, and the changes brought about by Christianity. Thus we proceed through the Middle Ages and the Renaissance to the modern period, in which attention is confined to England and America. In this section there is a chapter describing the influence of the industrial revolution on the family, and elsewhere the influence of chivalry is discussed, but, broadly speaking, as we pass from chapter to chapter we feel ourselves in a different atmosphere without knowing exactly what it is that has brought the change about. In consequence, the book is more like a selected series of panoramic views than a history in the strict sense. It may be that the author's treatment is the only possible one, but in that case why has so much been omitted? Except for the Hebrew, the Asiatic civilisations are entirely omitted; Egypt is not mentioned, and an important institution like the "Conseil de Famille" escapes notice.

Obviously, the subject so interpreted is one of vast range; indeed, we have only to interpret widely enough to make it include the greater part of the history of civilisation. Prof. Goodsell himself takes a wide view and includes much of that side of human conduct which springs directly from the sex-impulse. Modes of courtship, prostitution, education in matters of sex, household furniture, clandestine marriages, Platonic love are examples. The odd way in which they occur in the various sections helps to destroy the unity of the book and to confirm the "panoramic feeling" previously mentioned. Accessibility of material rather than a philosophic plan seems at times to have led the author into side-tracks, attractive and interesting enough in themselves, but *culs-de-sac* in spite of that, from the point of view of the subject as a whole.

A short notice of this kind cannot cover the ground of such a book, though even a casual reader will be struck by a want of precise references in certain of the chapters, particularly, perhaps, in that dealing with the primitive family. Where is the "weight of evidence" which shows that polygamy is unpopular among savage women? The author gives several reasons why *we* condemn it, but there is surely room for doubt whether deprivation of the father's care in the rearing of children or any other of the alleged reasons for this feeling could have operated—indeed, Prof. Goodsell himself suggests this, for he says on the preceding page that primitive man could not be aware of the physical and moral advantages which monogamy brings. How much attention could the politically occupied citizen of Athens give to the care of his children? And what of men in the modern industrial State? What proportion of men in our day feel this particular disability? In the same chapter the author has clearly confused the household and the village community as it still exists in Russia. It is the whole community which owns the land, not the related families living under one roof, and communal authority, not patriarchal, which allots the land to the householder.

His account of Greek family life omits all reference to the Spartan system of common meals, so much admired by Plato and Aristotle. It does little justice to Plato's high-minded, if mistaken, attack upon the family, and still less to Aristotle's defence of it. Both these philosophers raised moral and educational issues in this connection which should have found a place in a book which gives considerable space to Edward Carpenter and Ellen Key amongst the moderns.

From the particular point of view of education the book is perhaps least satisfying, but the task which Prof. Goodsell undertook was one of extraordinary difficulty. It called for scholarship of a high order, and, above all, for a philosophical outlook which would help to preserve unity of aim and balance of treatment. Although defective in these respects, the book is full of human interest. The pictures of home life in the old colonial days are especially so. As a collection of facts connected more or less closely with the family, many readers will find pleasure in its perusal, and as each chapter closes with a long list of references it may serve as a very useful introduction to a subject of vast interest and importance.

J. A. GREEN.

FORECAST BY MR. WELLS.

What is Coming? A Forecast of Things after the War. By H. G. Wells. Pp. 295. (London: Cassell and Co., Ltd., 1916.) Price 6*s.* net.

WHEN Mr. Wells writes upon social and political questions he is a prophet whom it is a pleasure to follow, even when we feel that time will prove his extrapolation careless. What mistakes he may have made in this book will declare themselves in a year or two, so that he has placed his reputation in more jeopardy than usual. He believes that Germany will be beaten, but not completely crushed by this war; "she is going to be left militarist and united with Austria and Hungary, and unchanged in her essential nature; and out of that state of affairs comes, I believe, the hope for an ultimate confederation of the nations of the earth." The Central Powers remaining a menace, the Allies and America will reform all their methods. It is in discussing these reforms that Mr. Wells is at his best; he is on his own familiar ground, and he excites the admiration and sympathy of his most exacting critics. The chapter, "Nations in Liquidation," contains in one sentence his great idea: "The landlord who squeezes, the workman who strikes and shirks, the lawyer who fogs and obstructs, will know, and will know that most people know, that what he does is done, not under an empty, regardless heaven, but in the face of an unsleeping enemy and in disregard of a continuous urgent necessity for unity."

Thus we shall have a millennium induced by the German menace: we wish we could believe in it. In the chapter, "The Outlook for the Germans," we find that he relies upon the great middle class to save Germany from Junkerdom. He does not take into account the fact that the German nation must get tired of being intense and perhaps may even get disgusted with "Kultur." Readers know his views on Socialism, and they can imagine how he mocks at our present want of organisation, our rottenness and dishonesty, and how in particular he makes war against the lawyers and schoolmasters. There is a good chapter on "What the War is doing for Women."

Mr. Wells's whole scheme is based on his belief that the Central Powers will continue to menace the world, and this belief is itself based upon a certain hypothesis which might almost have been called an axiom five months ago, when Mr. Wells wrote. This hypothesis is that in entrenched warfare the defensive has an advantage over the most brilliant strategy and over considerably superior numbers, and that there must be a deadlock, followed by the complete exhaustion of both sides. If Mr. Wells had waited only a few months he would have seen that the great wealth and patriotism of England and the enormous population of Russia and the intense feeling of France now enable the Allies to break through the long German fortifications at all points with advantages in power which get greater and greater every day, so that the deadlock is already at an end. Exhaustion in men is possible, and as there are more than twice as many available soldiers with the Allies as with the Central Powers, the speedier exhaustion of Germany in men is quite certain. As for exhaustion in wealth: in two years of the Napoleonic war we spent one-third of a million pounds per day. In a week we spent as much as Charles II. spent in a year. Now we have reached an expenditure of six millions per day, and yet unscientific persons refuse to recognise that the wealth of England is unimaginably great, and that the steam-engine has given us the whole earth in fee.[1] Germany in 1871 thought, and everybody thought, that she had ruined France financially. We know now that if she had enforced an indemnity ten times as great France would have paid it easily. We talk of the cost of the war to Germany spelling her financial ruin, whereas those scientific persons who have studied Germany know that at the end of this war, if we compel Germany to pay the total expenditure of the Allies (we do not recommend this), she will still be in a flourishing condition. Mr. Wells thinks that the world peace is coming soon through universal self-sacrifice; it is a guileless notion. Peace will come to the world by such a loss of its wealth as people do not think about—by the exhaustion of its coal. The man in the street who reads scraps of scientific literature believes, like the spendthrift, in a miracle—namely, that unknown stores of wealth will be opened up when our coal fails. Before the war we recognised with sorrow that he was wrong, but we have less sorrow now when we know that our greatest blessing has become a curse.

J. P.

OUR BOOKSHELF.

The Cruise of the "Tomas Barrera": The Narrative of a Scientific Expedition to Western Cuba and the Colorados Reefs, with Observations on the Geology, Fauna, and Flora of the Region. By John B. Henderson. Pp. ix+320. (New York and London: G. P. Putnam's Sons 1916.) Price 12*s.* 6*d.* net.

THIS book is the narrative of a "delightful outin[g] and a most successful collecting expedition" to th[e] north-west end of Cuba. The account throughou[t] is essentially domestic, the doings of each da[y] are recorded, and there are the usual more or les[s] informed pages on mosquitoes, snakes, an[d] sharks. It was a scramble of nine "naturalists" for six weeks to secure specimens of as man[y] different animals as possible, rather than to stu[dy] scientific problems or living beasts. The co[l]lectors secured a well-found fishing schooner [of] 65 ft. length, with a launch, and dodged in an[d] out of the barrier reefs of the Colorados, wherev[er] possible securing specimens by shallow dredgin[g] the use of copper sulphate for doping rock poo[ls] and the attraction of the electric bulb at nigh[t]. It is a slightly known area, but reefs, lagoo[ns]

[1] It has been proved that the steam-engine has multiplied the wealth [o]f the world by some number between 200 and 1000.

and mangrove swamps seem to be little different from others in the same region. No fresh light is thrown on their origin. They differ mainly from Indo-Pacific reefs in the shallowness of the lagoons—seldom more than ten fathoms—within the barrier reefs, but, unfortunately, in an otherwise well-got-up book, the chart given is totally inadequate.

Some of the party were more interested in the land than in the sea, and much of their time was spent in hunting for land-shells. It is upon the great limestone ridges (sierras) which stretch through Cuba from east to west that that island's astounding wealth of land mollusca is found. In addition, there are isolated mounds of limestone (mogotes), rich in peculiar genera and species. The author is an authority on these, and we are sorry not to hear much more of them. Clearly he considers that the land mollusca reached their climax after the elevation of the limestones, apart from which they cannot maintain themselves. Later, abrasion has been at work, and their original range has dwindled as continuous limestone areas were replaced by broken sierras and isolated mogotes. Isolation in plastic genera gave rise to the formation of new species. The widely distributed families, genera, and species are hence the ancient forms, the isolated genera and species their modern descendants.

The Statesman's Year-Book. Statistical and Historical Annual of the States of the World for the year 1916. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xliv + 1560 + maps 4. (London: Macmillan and Co., Ltd.) Price 10*s*. 6*d*. net.

THE "Statesman's Year-Book" makes its ever-welcome appearance. The editors, Dr. Scott Keltie and Dr. Epstein, have been able to obtain much statistical information regarding the belligerent countries, and, in the case of Germany, to include facts and figures based upon the latest officially published information. Maps show the railway schemes in Asiatic Turkey and in Africa respectively, and the distribution of Germans both in the world as a whole and, in greater detail, in the United States. The introductory tables provide a world review of the production of wheat, sugar, ships, etc., and usually include the year under review. There is an illuminating summary which deals with the Great War in regard to population, books, loans, and war finance. The Allies outnumber the Central Empire Alliance by 5 to 1; the war has cost already more than 10,000,000,000*l*., of which a quarter has been spent by Britain, nearly a quarter by Germany, and a fifth by Russia. Mr. John Leyland has revised the information concerning the navies of the world in succession to the late Mr. Fred T. Jane. We cull a few facts at random: There is a volunteer corps among the 2328 males in the Falkland Islands; Oregon University, organised in 1876, has 108 professors; the Free City of Bremen in 1913 exported goods valued at 10,110,000*l*. to Great Britain, about 9 per cent. of the total exports of the port.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Is Proto-Oxygen the Principal Constituent of the Atoms?

As from Moseley's experiments we know the number of rare-earth elements between La and Ta to be 15, the mean difference between atomic weights is, from Mg on, for 6 atomic numbers, 16 exactly. So for Mg (Atw. 24, N 12) and Th (Atw. 232, N 90) we get $(232-24)/16=(90-12)/6=13$. Between U and Nt this difference of $238-222=16$ is known to be a difference of $4\alpha+2\beta$ particles. But if the α particle is the real constituent of the atoms, $4\alpha+2\beta$ is the inner part of the oxygen atom (the additional 6 β particles being electrons of valency). That atomic weights are not twice the atomic numbers would be due thus to the formation of $\alpha_4\beta_2=\theta$ particles, or proto-oxygen, within the nucleus, and radio-activity should be the disintegration of these θ particles into their constituents. It may be remarked that $\alpha_4\beta_2=\theta$ is similar to $H_4^+\beta_2=\alpha$ (which might be the formula for the α particle). A. VAN DEN BROEK.

Gorsel, Holland, July 17.

International Commission on Zoological Nomenclature.

OPINIONS on the following subjects are before the International Commission on Zoological Nomenclature for final vote:—

Opinion 70.—The case of *Libellula americana*, L., 1758, vs. *Libellula americanum*, Drury, 1773.

Opinion 71.—Interpretation of the expression "typical species" in Westwood's (1840) synopsis.

Opinion 72.—Herrera's zoological formulæ.

Opinion 73.—Five generic names in Crinoidea, ninety-two generic names in Crustacea, and eight generic names in Acarina, placed in the official list of generic names.

If anyone is interested in these opinions and has not already been reached by the Commission, and therefore has not had an opportunity of being heard upon them, he is cordially invited to send his views to the Secretary of the Commission, and if any new point is raised that is likely to alter the opinion of the Commission, the data will be forwarded to the Commissioners for consideration.

C. W. STILES,
Secretary to the Commission.

Office of Secretary to International Commission on Zoological Nomenclature, Smithsonian Institution, Washington, D.C., July 13.

The Magnitude of θ Eridani.

THE arguments of Mr. E. J. Webb (NATURE, vol. xcvii., p. 341) seem conclusive as to this star having been of the first magnitude at the epoch of Ptolemy's catalogue, but are perhaps less conclusive as to its magnitude at any other time, though the reviewer of Peters's and Knobel's work is surely wrong in assuming that Al Sûfi would find any difficulty in judging between a first and a third magnitude star at an altitude of 10°. Have astronomers considered the possibility of θ Eridani having been practically a temporary star at Ptolemy's epoch? Do Peters and Knobel come to any conclusion as to the magnitude of this star? T. W. BACKHOUSE.

West Hendon House, Sunderland, August 4.

SOUTH AFRICAN UNIVERSITY LEGISLATION.

PUBLIC discussion, extending over many years, in the Press and in Parliament, on higher education in South Africa has at length resulted in legislation. The old University of the Cape of Good Hope, with its offices at Capetown, was merely an "examining" institution, founded on the model of the University of London. The constituent colleges were (the figures give distances in miles from Capetown):—The South African College at Capetown, the Victoria College at Stellenbosch (31), the Huguenot Ladies' College at Wellington (45), the Rhodes University College at Grahamstown (757), the Grey University College at Bloemfontein (750), the Natal University College at Pietermaritzburg (1182), the Transvaal University College at Pretoria (1001), and the South African School of Mines and Technology at Johannesburg (956). There are many objections to a university which is a mere examining body; there are many objections to a university the constituent colleges of which are separated even by such short distances as are Liverpool, Manchester, and Leeds; it has long been felt that all such objections are greatly magnified when a meeting of Senate cannot be held unless many of its members spend six or eight days in travel. It scarcely needs the words of the report of the University Commission (p. 138) to let us know that, in spite of having distinguished, well-paid professors, the only work done by the colleges hitherto has been mere cramming for examinations, and that there is an almost total absence of the university spirit in South Africa.

In 1904 Mr. Alfred Beit gave an estate near Johannesburg to the Government of the Transvaal (this was before the union of the States under one Government) for agricultural and other educational purposes. The estate is probably worth 20,000*l.* now. In 1905 he made a will giving 200,000*l.* to the University of Johannesburg for university buildings on the estate; "but if, at the expiration of ten years after my death, the said 200,000*l.* shall not have been applied in such building and equipment as aforesaid, then this legacy shall lapse and fall into my residuary estate." Even now there is no university at Johannesburg, nor is there any college of university rank except the School of Mines. Mr. Beit died in 1906. In 1910 General Smuts, the Union Minister of Education, suggested to Mr. Otto Beit (his brother's heir) and to Sir Julius Wernher that Mr. A. Beit's bequest ought to be increased to 500,000*l.* for the establishment of a national university on the Rhodes estate at Groote Schuur (at Capetown), which belonged to the Government. Sir Julius promised 250,000*l.*, and Mr. Otto Beit 50,000*l.* The De Beers Company offered also 25,000*l.* In a joint letter Sir Julius Wernher and Mr. Otto Beit said that "the primary condition underlying the gift . . . was that the university to be erected shall and must be a residential teaching university."

There was universal approval all over South Africa of the idea of a residential teaching university at Capetown, but it soon appeared that there was room for divergent opinion as to th nature of such a university. A proposal largel approved of and soon after almost universally con demned was that the new institution should be "post-graduate" university. Then came a ne proposal, so favourably received that it was em bodied in a Parliamentary Bill, that entrance t the new university should require "intermediate qualifications, and not merely the ordinar matriculation. To this proposal, also, oppositio became too great, and the Bill was withdrawn Before 1914 there was a general expression o opinion in favour of two universities—north an south. A University Commission met in January 1914, and reported just before the war in favou of two universities—a southern university wit new buildings on the Rhodes estate at Capetown incorporating the South African College and th Victoria College, and a northern university in corporating all the other colleges. The committe recommended that 350,000*l.* should be spent i buildings and equipment at Capetown, that Stellenbosch should get 25,000*l.*, and that the rest o the money should be distributed among the mor distant colleges.

Prof. John Perry, who was one of the commissioners, agreed to the more important recommendations of the report, only with reservations; he especially wished half a million to be given to a teaching university at Capetown so that South Africa might have at least one real university. He said that no scheme could succeed unless Stellenbosch had some endowment, and he proposed that to the 25,000*l.* there should be added a Government grant of 50,000*l.*, and also that Stellenbosch should be encouraged to gather more money so that she might soon apply for charter of her own. In that case the Capetown University would consist of the South African College only. Prof. Perry was strongly of opinion that no distant college, such as that of Grahamstown, should be incorporated with Capetown, and in this consisted his greatest difference from hi colleagues. This gentleman's recommendations have now been carried out in an Act of Parlia ment. The South African College is to becom "The University of Capetown," with its presen buildings and new ones on the Rhodes estate, an with 525,000*l.* The Victoria College is to becom "The University of Stellenbosch," a recent be quest of 50,000*l.* by Dr. Marais taking the plac of the proposed Government grant. (There ough certainly to be a large additional grant from th Government.) The proposed northern universit is to be called "The University of South Africa. It is to be hoped that the Johannesburg Scho of Mines will soon apply for a charter of its own it is already nearly as well equipped as any poly technic in the world.

Now that the scheme has been carried ou the people of Johannesburg make objection having awakened to the knowledge tha except for their School of Mines, they hav no teaching there of a university charact nearer than Pretoria, which is forty-five mil

distant. On March 28, 1914, their educational authorities said: "The scheme for founding a great residential university at Groote Schuur has our hearty and unanimous support. We are prepared to abandon any local ambitions we may have had in favour of this truly national enterprise, even though it involves our losing the revenue we at present derive from the Beit bequest." It is difficult to see why objections should now be brought to the very university which two years and a half ago had the unanimous approval of the Rand. Public meetings have recently been held at which most of the speakers showed but little knowledge either of the history of the subject or of what is meant by a university. They have suddenly discovered that their rich district is being exploited for the benefit of Capetown, and that their great thirst for university education has been left unslaked, deliberately, by the Union Government. They are greatly mistaken. If these public meetings create such a thirst they will prove a godsend, for such a thirst cannot exist in rich Johannesburg without almost immediately creating a worthy university. We think that the people of South Africa ought to be very well satisfied with the recent university legislation. Some years ago the question was a very vexed one. There were great jealousies between north and south, but still greater were the racial difficulties, both in the north and south, and of all these troubles nothing remains except an apparent grievance at Johannesburg. It is to be hoped that the men who drew up that magnanimous statement of two and a half years ago will take advantage of the present agitation to give Johannesburg a teaching university of its own.

THE NEWCASTLE MEETING OF THE BRITISH ASSOCIATION.

WHEN it was first suggested that the 1916 meeting of the British Association should be held in Newcastle-upon-Tyne the conditions in that city were very different from what they are now. The same might be said of any town in Great Britain; but the war has affected Newcastle itself with no uncertainty; and the Northumberland and Durham miners, as well as the shipyard and engine workers, have contributed handsomely to the ranks of our New Army.

With this war atmosphere thickening as the demands of the Navy and Army became greater, it was natural that considerable discussion should arise as to the wisdom of holding the meeting in Newcastle this year. It was, however, finally decided to hold the meeting on September 5–9, on the understanding that it would be a purely business meeting, shorn of all the festivities, such as garden parties and excursions, to which the members are accustomed. In fact, the meeting will be on similar lines to those on which the Manchester meeting was run last year.

In normal times the meeting would have centred itself round Armstrong College, and in consequence the work of the Sectional Arrangements Committee would have been comparatively light; its spacious halls and lecture-rooms and its well-equipped laboratories would have provided that arrangement which is so eminently suited to a British Association meeting, viz. the reception-room and its adjuncts, as well as a large proportion of the section-rooms, in one building. Armstrong College, however, was taken over by the War Office during the early part of the war, and became, and still is, the 1st Northern General Hospital. Nevertheless, ample and satisfactory accommodation has been obtained; in several instances two or more sections will meet in the same building, and all the section-rooms are in close proximity to one another.

As in 1889, the reception-room will be the library of the College of Medicine, where also several section-rooms, smoke-rooms, writing-rooms, Press and general offices will be provided. The following list shows where the various sections will meet:—A (Mathematical and Physical Science), Trinity Church Rooms; B (Chemistry), College of Medicine; C (Geology), Friends' Meeting House; D (Zoology), Grand Assembly Rooms; E (Geography), Friends' Meeting House; F (Economic Science), Literary and Philosophical Society; G (Engineering), Institute of Mining and Mechanical Engineers; H (Anthropology), Friends' Meeting House; I (Physiology), College of Medicine; K (Botany), Grand Assembly Rooms; L (Educational Science), St. James's Church Rooms; M (Agriculture), Grand Assembly Rooms.

Sir Arthur Evans, F.R.S., the president-elect, will deliver his address on Tuesday evening, September 5, at the inaugural meeting, which will be held in the Town Hall. In the same hall on Thursday evening, September 7, Prof. William A. Bone, F.R.S., will deliver a discourse on "Flame and Flameless Combustion," and on September 8 Dr. P. Chalmers Mitchell, F.R.S., will deliver a discourse on evolution and the war.

Owing to circumstances incident to the war, it has been found to be impossible to arrange this year visits to the armament factories or the great shipbuilding and engineering works on the North-East Coast. A further announcement, however, may be made in the early future with regard to this matter. Nor will there be any excursions of the usual type, although it is understood that a number of the sections are promoting shorter excursions of special interest.

The Literary and Philosophical Society's Library, the Laing Art Gallery, the Hancock Museum of Natural History, and the Black Gate Museum will be open to members of the Association during the meeting. The majority of the clubs of Newcastle have granted temporary membership to those attending the meeting.

Following the course adopted at Manchester, the Association has again offered students and teachers of Newcastle and district associates' tickets at a reduced fee, and it is hoped that a large number will show their appreciation of this encouragement. Lectures to the public will be given in Newcastle, Sunderland, Durham, and Ashington by distinguished men.

SIR WILLIAM RAMSAY, K.C.B., F.R.S.

THE first scientific words, probably, ever printed from the pen of Sir William Ramsay read curiously now that the full chapter of his writings is closed. They served to introduce his career, and may, with an unexpected aptness, be recalled at its close. Though he left early, he left behind much that has already become a permanent part of the common heritage of science, well known to all. On this, once again for a moment, those now mourning his sad and untimely death may linger, loth to say farewell.

The words introduce his thesis for the doctorate at Tübingen under Fittig in 1872: "To determine the constitution of chemical compounds has been the endeavour of chemists ever since the mere discovery of new bodies has ceased to engross their chief attention." Little could the youth of nineteen then have tasted of the joys of discovery that he could so talk of "mere" discovery. Before him the unknown future held a career of discovery which was to raise him to an unchallenged pinnacle among his colleagues, not of new compounds, but of a whole family of new elements, unsuspected even though the Periodic Law had long since called their roll, and utterly different, in the entire negation of their chemical properties, from any kind of matter previously known. Yet fundamentally true the random words have proved themselves, even in connection with so great advances, in that crescendo of scientific accomplishment which heralded the coming of another century. It is no longer these discoveries that engross, but the problems of constitution to which they led up and contributed—no longer, however, the problem of the constitution of chemical compounds, but the key problem of all physical science and of materialistic philosophy, the problem of the constitution of the elements and the structure of the atom.

Ramsay, whatever had been his youth, training, or after circumstances, would never have been content to think the thoughts of others, nor to confine himself to the paths that they had roughhewn. His earlier work in physical chemistry—the determination of the molecular weight of liquids from their surface-tension with Shields, his work on accurate vapour density measurements, and his studies of vapour pressure with Young—already showed his disposition to stray from the well-beaten track. But the clue to the existence of a new gas in the atmosphere, found by Lord Rayleigh in the discrepancy between the density of atmospheric nitrogen and that prepared from compounds, started him off definitely into the trackless wild and gave his exceptional gifts full and free scope. Every faculty is now at its best, and in the field of chemistry so opened up little help is forthcoming from the current methods of experiment and deduction. In such an apparently trivial experimental detail, for example, as the choice of a suitable lubricant for taps and ground joints might lie the difference between mastery and total failure. Pertinacity, too, is called for to pursue a uniform series of negative results in the search for positive chemical properties of the new gases until the sum of the apparent failures should unite in a single satisfying positive conclusion, that the gases were non-valent, not merely exceptionally difficult to bring into combination. Lastly, new methods of reasoning from the physical qualities, in the absence of chemical, must be brought to bear before the atomic weight of these elements can be assigned and they can take their proper place in the scheme of elements.

Novel as it all appeared, fitting place was found for Ramsay's love of the early history of his subject and the delight he took in the work of the early pioneers. After a century's oblivion, the remarkable experiment of Cavendish on the sparking of air over alkalis was re-discovered, and another, and by no means the least, tribute so paid to the foresight of this remarkable man. Since then this same experiment has had on the industrial and practical side, in the fixation of atmospheric nitrogen, as remarkable a sequel as it received at the hands of Lord Rayleigh and Sir William Ramsay in the discovery of argon.

It is customary to regard the next step, which was essentially Ramsay's alone, the discovery of helium, as a very natural and direct development of his earlier work with Lord Rayleigh on argon. This is only partially true. In one sense the discovery of helium was entirely distinct; for, though, like the other inert gases, it exists in the atmosphere, unlike all the others it was not discovered there. The name, of course, recalls the long arm of scientific method and the discovery of the chief of its spectrum lines in the spectrum of the sun's chromosphere by Lockyer and Frankland in 1868. By the way, would it not be a graceful tribute to Ramsay, and also a step in the right direction of a consistent nomenclature, to rechristen this gas "helion," so making it correspond with the other members of the family, argon, neon, krypton, xenon, and, by chance, the three isotopic radioactive emanations?

When Ramsay came upon this gas for the first time, as it were, face to face in the gases from the uranium minerals which Hillebrand ha thought to be nitrogen, recognised its signatur in the λ of its D_3 line, and found that it was onl present in minerals containing uranium an thorium, he broke, unawares, new ground in a field totally unconnected with that hitherto cul tivated for argon. His proof that it possesse the same absolute lack of chemical combinin power, his immediate recognition of the fact tha he had found a second member of what was a ne family of elements of which probably mor existed, and the successful separation of these and also helium itself, from the atmosphere i collaboration with Travers, brought back th research into its former course. The significan of the remarkable fact that helium alone of th inert gases existed otherwise than in a free stat in the atmosphere, and that, in spite of its tot lack of combining power, it was found pent u somehow in uranium and thorium minerals, wa grasped only later by others. But it was esse tially the starting point of a new departure whic

in the fullness of time was again to link itself with its source.

It has been well remarked of Ramsay that he stood to the outside world for an essentially British school of chemistry. To describe him as original would be like saying water is wet. He was of the essence of originality, and, during the time the writer knew him, entirely without any apparent sheet-anchor of fixed conviction or established belief in scientific doctrine, which at all times, in a science somewhat prone to let go sheet-anchors, made him a unique and almost incomprehensible personality. It is true that in his later years he suffered from the defects of these qualities, and he failed to criticise sufficiently his own ideas and experimental results before making them public. He seemed to lose something of that sense of the great and terrible responsibility which must at all times rest heavily on the scientific leader, and never more than in the case of the pioneer. All through his work, probably, his collaborators had perforce to assume to an undue extent the *rôle* of "devil's advocate," and much of his best work was done in partnership with those who recognised this. But in the zenith of his powers at University College and in the full swing of his elucidation of the family of inert gases, he trod fearlessly and without an error the difficult path of the pioneer and won a permanent right to something far greater than the title of a successful discoverer. Argon, helium, neon, krypton, and xenon were capital discoveries, but the bringing of this group into harmony with the rest of the elements might have appeared a task almost insuperable in the face of their total lack of chemical properties. The recognition that they were monatomic and non-valent gases occupying a "zero" family of the Periodic Table, preceding that of the monovalent alkali-metal family, from which hitherto the table had seemed to start, was made in spite of the fact that argon itself is an "exception," in the orderly sequence of elements, of the same type as tellurium, which was then a very hotly debated and puzzling question.

This was physical chemistry in a sense as original and bold as the great thermo-dynamical and electro-chemical generalisations of the American and Continental savants, which hitherto had almost monopolised the term. It initiated a widening of the domain that was to grow apace. The human mind seems incapable in its initial processes of grasping thoroughly more than one fundamental point of view at a time. Each has to be grasped separately before both eyes can be opened without the image becoming blurred. The phlogistonists had a single eye for what we now call energy, Lavoisier for what we now call mass. The first physical chemists found the thermodynamical point of view so clear-cut and complete that some of them sought to banish from their conceptions the molecular and atomic viewpoints as unnecessary, unproved, and unprovable hypotheses. Ramsay, confronted with a type of element utterly devoid of chemical properties and forced to rely entirely on their physical properties to put them in their proper relation to the whole, solved the problem completely and correctly by the aid of the molecular and atomic conceptions alone, though it is only lately that opposition to his views has entirely died down. Before he died he had the satisfaction of seeing this his own side of physical chemistry developed, by the discoveries in connection with radio-activity and the Brownian movement, to an amazing extent. The physical reality of atoms and molecules has been demonstrated by methods of great directness and power; and these, incidentally, applied to the case of his own gases, confirmed his earlier interpretation of their monatomic character in a way that made further cavil impossible.

But now we must go back to 1896, to the year of the discovery of helium and to the year that Henri Becquerel in Paris discovered the radioactivity of uranium, but a few months after Röntgen had given to the world a sixth sense. In Becquerel's footsteps M. and Mme. Curie were starting on the quest which led to radium. Rutherford had come from the mirror image of our islands in the Southern Seas to learn at the Cavendish Laboratory under Sir J. J. Thomson, and with him to forge the weapons of measurement and discrimination which, in the new sciences that the dying century had called forth, were to prove their sufficiency. His specific recognition of the α-rays was one of the first-fruits of the new methods, which, a little later, in Canada, at the McGill University, in the fine Macdonald science laboratories, were to play such an important part in the amazing succession of discoveries that followed, and which culminated in the complete and satisfying explanation of radio-active phenomena which is accepted to-day.

Then, by one of the strangest combinations of destiny, the centre of interest shifts again for the moment back to the laboratory where helium was discovered, as the associate of uranium and thorium in minerals, seven years before, to Sir William's private laboratory at University College. Word had passed along the underground corridors below, and the room had swiftly and silently filled with a throng of staff and students, clustering round those fortunate enough to possess a pocket spectroscope, all making the one short remark, "Yes! it's helium." For that was the room where was being put the coping-stone to the arch that in seven short years had sprung up from the twin discoveries of the rare gases and of radio-activity, and Sir William was witnessing with the spectroscope the first ocular proof of the genesis of helium from radium, which had been predicted from the theory of atomic disintegration. Nobody can deny that destiny, so frequently erratic, here made a happy choice, not only because the original discovery of helium was made by Ramsay, but also because in his laboratory had been worked out those delicate methods of gas manipulation which alone were equal to dealing with the minute amounts of helium involved in this investigation.

In another direction there was an intimate connection between the discovery of the inert gases and radio-activity. The "radio-active emana-

tions" discovered by Rutherford were shown to be inert gases of the argon type, and Ramsay, having satisfied himself of this, enthusiastically took up the study of the radium emanation, and made an exhaustive study of its physical properties, largely in conjunction with Whytlaw Gray. In his research on xenon his methods of gas manipulation had had a severe test, two or three cubic centimetres of gas being the total stock available after working up an enormous quantity of air. But in the case of the radium emanation, only a small fraction of a cubic millimetre at most can be obtained at a time, and the methods were tried to the uttermost. The extraordinary amount of information which these workers and also Rutherford were enabled to obtain about the physical constants of the new gas in approximately pure condition is one of the triumphs in the investigation of minute amounts of matter. In this research also the extraordinarily delicate micro-balance, devised by Steele, found something worthy of its powers.

For many of the latter years of his life Ramsay brought forward evidence to show that the energy liberated in radio-active transformations was sufficiently powerful to bring about the transmutation of one element into another. But these and similar attempts to produce artificial transmutation by radio-active and electrical agencies are not yet accepted by the majority. The subject is undermined with pitfalls, and to history must be left the final judgment on this thorny question.

The writer's personal acquaintance with Ramsay dates only from 1898, and his association with him only from the time when his great work on the rare gases of the atmosphere was completed. His views, therefore, can only be partial, and as regards one of the most fruitful periods of his life indirect. In 1898 a group of honours candidates in white ties outside the chemical laboratories at Oxford was joined by the distinguished examiner from London, whose discoveries were upon everyone's lips. We were chaffed at the state of our hands, yellow from a nitrification set upon the previous day's examination, and we were assured that we need not scruple to accept an invitation to dinner, as the stains were quite invisible by artificial light!

The instant popularity of such a man with his juniors and students is not difficult to account for. At University College he was looked up to by them in a way that can scarcely be expressed. He was at once genial, approachable, and great—any of which alone is an infallible passport to the student's heart—and he repaid their trust and affection with a loyalty to them as complete as that of a Scottish chieftain to his clan. But even among those who, at one time or other, may have been sharply in conflict with him—and among contemporary chemists none probably have been the centre of so much controversy—there must be few who did not feel the fascination of his personality, and are not now among the multitude of friends and admirers who feel his loss as personal and irreplaceable. It may be worth recording, seeing the stormy time through which he passed, that one who had known him well all his life could say to the writer that he had never heard a really unkind thing said by Ramsay of any of his colleagues or opponents. Not only his personal friends and whole-hearted admirers are to-day among those who are feeling that "they loved the man and revere his memory."

FREDERICK SODDY.

IT was in 1880 or 1881, very soon after Ramsay had come to the Bristol Chair of Chemistry, that late one very hot and sultry summer evening a newly made friend, tennis-racquet in hand, came to seek him in his private laboratory. "Ah, I'm glad you've come. No, I'd not forgotten, but I've had trouble with this and a long day of it, but it is all right now, and I'll come." Across the window of the narrow make-shift room of the old building that served as the first home of the University College stretched the long length of a complicated system of glass bulbs and tubes and mercury pumps in which he was conducting a distillation for one of his vapour pressure investigations. At that moment some ill-annealed junction, perhaps too near a flame, cracked and gave way; air entered with a hiss and reversed the flow of hot liquid; another crack and then a crash—for, though he sprang to save it, a large mercury receiver broke and discharged its contents over the edge of the table on to the floor, where most of it disappeared between the ill-fitting boards. "Well," thought the friend, "that will be the end of this day's work." But he did not yet know Ramsay, who, looking up with a rueful smile, said: "I'm afraid this means no tennis for me to-day." "What are you going to do?" "Take up the floor and recover the mercury—and a dirty job it will be." And so it proved; but by next morning the mercury had been recovered and the apparatus had been rebuilt and was at work again. That was Ramsay at the age of twenty-eight, this my first glimpse of the indomitable energy which was one of the secrets of his noble career. In the thirty-six years that have elapsed since then it seemed to me that his instinct and practice were always the same: so soon as any demand for action came, to make up his mind what to do and then to act at once. Ask any of the hundreds of friends who have sought and received his help and you will hear from all sides how quickly as well as how generously the help was given.

This energy in action was the outcome of a remarkably healthy and vigorous physique, which he knew how to attend to; and any challenge to which in a feat of skill was accepted as an intentional exercise. A fifty-mile bicycle ride left him quite willing to walk another twenty miles. This tireless physical vigour without doubt contributed to the attainment of his well-known mechanical skill in glass-blowing and to the steadiness of hand and eye which underlay many of his great experimental achievements. So, too, his quickness in picking up foreign languages was partly due to his fine and acute musical ear. Even the sense of smell was for him an instrument of analysis the

use of which he had learnt to push far beyond the limits of ordinary expectation, and was the subject of more than one scientific communication.

Such was the happy physical endowment at the command of the eager and affectionate spirit which, wherever he went, made William Ramsay so extraordinarily lovable and acceptable to all classes of men. A man so harmoniously constituted is not often met, and there have been many moments when, watching my friend in the midst of his ideally happy family surroundings, I have said to myself that I have never seen an expression so beautiful and radiant on any human countenance. "Radiant energy" is the phrase that best recalls and summarises his personal characteristics.

No accession of honours or acclamation spoilt for one moment the childlike simplicity of his character. Of course he enjoyed them, but that his friends should rejoice seemed what he cared for most. They brought him new and enlarged intercourse, but the old channels of quiet and tried affection ran deep and full as ever; discussion was as free, as patient, and as fruitful. Genius of any kind he always disclaimed. "It is all pure luck and pegging away," was his phrase; or, as he insisted when revisiting the Scientific Club at the Bristol University, which he had helped to found twenty-one years before, his chief asset in any success he had attained had been a "shocking bad memory," which prevented his recollecting a chemical or physical fact of which he had been told or had merely read, till he had forced himself to rediscover it in some phenomenon within his own experience. Then, indeed, he admitted that he never forgot it. It was, I think, a similarity of instinct for learning by an experimental appeal in which physical sensation should be involved that first drew us together.

Any mistakes he made were those inevitable to an eager and impetuous temperament. Always grateful for help, he sometimes over-estimated the abilities of the friend who gave it. Accustomed to find difficulties yield to his own labour and ingenuity, his sanguine expectation sometimes blinded him to obstacles which were destined to prove insurmountable. Unsuspicious and always approachable, and a little impatient of the limitations of scientific orthodoxy, he found that he had sometimes lent too ready an ear to representations that were to prove untrustworthy; but, being willing to follow ten false clues rather than miss one real one, he was ever more afraid of the consequences of over-caution than of over-confidence.

So wide were his sympathies and interests and so quick his ability to take in new ideas or follow a subtle argument that men of every profession and workers in every branch of science found in him an ideal listener, and were stimulated by his quick grasp and pertinent and suggestive inquiries, and so it came to pass, as it seemed to us who watched him from the ranks, that he moved among the leaders of thought in any sphere and in any country, recognised as intellectually their peer, while behind all his questionings burned continually the passionate desire to help to unravel the mystery of life and the significance of the physical universe. "Most men," he once lamented to me, "have no interest in physical facts of Nature. They pretend interest because they cannot ignore the palpable results of applying science, but the things in themselves are absolutely without interest for them." How this interest might be aroused by education was a matter that he was always ready to discuss.

Of all his most intimate friends who had already passed away, none was more deeply mourned by him than G. F. Fitzgerald, whose suggestion and counsel were ever at his disposal. *Par nobile fratrum!* let us always remember them together.

A. M. Worthington.

ROLAND TRIMEN, F.R.S.

Roland Trimen, the third son of Richard and Marianne Esther Trimen, of 3 Park Place Villas, Paddington, was born on October 29, 1840. He was educated at King's College School, which he entered in 1853, having previously been a pupil at a private school at Rottingdean. When about eighteen he took the voyage to Capetown for the benefit of his health, returning to England in 1859. In the following year he again sailed to Capetown and entered the Cape Civil Service. In 1872 he was appointed Curator of the South African Museum in succession to E. L. Layard. In 1881 he was appointed sole commissioner to the Phylloxera Congress at Bordeaux, and in 1886 a member of the Commission for extirpating this pest from the Cape vineyards. In 1892 he became a member of the Cape Fisheries Commission.

In 1883 he married Miss Blanche Bull.

In 1895 Trimen was compelled by the state of his health to resign the curatorship of the Capetown Museum and return to England. He became a Fellow of the Royal Society in 1883, and was awarded the Darwin medal in 1910. The general feeling of naturalists when this award became known was well expressed in the letter of congratulation sent by the Entomological Society of London to their past president of 1897-98:—

"Among living naturalists there are few indeed whose merits as associates and fellow-workers with Darwin can bear comparison with your own; and we feel sure that all alike, in rejoicing at this public recognition of your life-long services to biological science, will agree that the present honour could not have been more worthily bestowed."

Trimen contributed the third of the three great papers which laid the foundations of the study of insect mimicry, and were published by the Linnean Society in 1862, 1865, and 1869. The dates of the two latter are generally quoted as 1866 and 1870, the years of the *volumes* of transactions; but the papers were published in the *parts* issued in the previous years. The first, by Bates, dealt with the Lepidopterous fauna of the Amazon valley; the second, by Wallace, with that of the East; while Trimen completed the survey by extending it to Africa. In this he had perhaps the hardest task

in solving the extraordinary problem of *Papilio dardanus*, then known as *merope*, with its train of mimetic females. His sound conclusions were in advance of their time, and were received with incredulity, and indeed ridicule, by entomologists of that day; but he lived to see them confirmed by breeding experiments and universally accepted. The last time the present writer saw him, a few weeks before his death, he found that a new observation on *Papilio dardanus* was the one subject that restored for a moment his failing powers and brought back his old enthusiasm.

Trimen's greatest work is his fine monograph in two volumes on the butterflies of South Africa, the expansion of a smaller book he wrote when a young man. This fine work is a model not only for its high scientific value, but also for a literary grace which was characteristic of all its author's writings.

Roland Trimen was full of humour and a delightful companion, and inspired the warm affection of a wide circle of friends. By his death the world has lost the last of the six naturalists who created the modern study of insect bionomics—Darwin, Bates, Fritz Müller, Wallace, Meldola, and Trimen.

E. B. P.

NOTES.

THE American Academy of Arts and Sciences has elected Sir Norman Lockyer a foreign honorary member.

IT is announced that the Daylight Saving Bill has been rejected by the New Zealand House of Representatives.

WE announced in our issue of March 16 last that an Association for the Advancement of Applied Optics had been formed in the city of Rochester, N.Y. We now learn of the recent formation of a national society called the Optical Society of America, of which the association at Rochester referred to by us is a section. It is proposed to hold annual meetings, and that the society shall serve as the parent organisation for local sections holding frequent meetings. It is intended to cover all branches of optics, theoretical and experimental: pure optics, lenses and optical instruments, optical glass and refractometry, colorimetry, vision, photometry, illumination, radiometry, polarimetric analysis, photography and similar related subjects; and to begin the publication of an international optical journal in January next. The officers of the society for the year are:—President, Dr. P. G. Nutting; vice-president, Dr. G. E. Hale; treasurer, Mr. A. Lomb; secretary, Dr. F. E. Ross. The executive council consists of the above-named officers and Dr. F. E. Wright, Dr. C. E. K. Mees, Mr. N. Macbeth, and Prof. J. P. C. Southall.

THE fifth Brazilian Geographical Congress will be held at Bahia on September 7–16. There will be twelve sections, devoted respectively to the following subjects: Mathematical Geography (astronomical geography, topography, geodesy); Physical Geography (aerology, oceanography, geomorphology); Physical Geography (hydrography, potamology, limnology); Vulcanology and Seismology; Climatology and Medical Geography; Biogeography (phytogeography and zoogeography); Human Geography; Political and Social Geography; Economic and Commercial Geography, including Agricultural Geography; Military and Historical Geography; Teaching of Geography, Rules and Nomenclature; Regional Monographs. Papers intended for presentation must not have appeared elsewhere, must be typewritten, and reach the Secretary of the Organising Committee not later than August 30.

WE learn from the *Museums Journal* for August that the present Lord Avebury has handed to the British Museum authorities, for retention in the national collection or distribution among provincial museums, certain portions of the late Lord Avebury's collection of prehistoric and ethnographical specimens from various parts of the world, use of which was made in the writing of "Prehistoric Times." The gift includes a fine series from the early Iron age cemetery at Hallstatt, Upper Austria, which will be kept in the British Museum, but many of the stone implements are available for distribution, and a list of them is given in the journal. Applications for specimens should be made to Sir Hercules Read at the British Museum.

As already announced, Sir William Henry Power, K.C.B., F.R.S., medical officer of the Local Government Board from 1900 to 1908, died on July 28 last, after a lingering illness. Greatly distinguished as an epidemiologist and administrator, his services to hygienic science and practice had extended over a period of more than forty years. Owing to a retiring disposition and a dislike for gatherings of a social nature, he was comparatively little known outside official circles. Nevertheless, during his long connection with the Local Government Board he planned and directed a large part of the work of the Medical Department, and numerous reports dealing with matters concerning the public health issued during that period were either written by him or owed much to his editorial criticism and supervision. His was a charming personality, which endeared him to all his colleagues, many of whom benefited to no small extent from his kindly help and encouragement, always so readily accorded. He was the first (in 1878) to direct attention to the dissemination of diphtheria, and later of scarlet fever, through the consumption of milk; while his classical work on the spread of smallpox from hospitals in which cases of that disease were under treatment formed the basis of legislative action resulting in the removal of smallpox hospitals out of the metropolitan area. While medical officer to the Local Government Board he also served on the General Council of Medical Education, and the Royal Commission on Tuberculosis, of which he afterwards became chairman. He was also appointed a member of the Royal Commission on Sewage Disposal. He received the C.B. in 1902, and the K.C.B. in 1908 on retirement from his official post. He was elected F.R.S. in 1895, and was awarded the Buchanan medal of the Royal Society in 1907. It is not too much to say that no man in this country has done more than Sir William Power to advance the cause of scientific hygiene.

THE many friends and scientific associates of Prof. W. A. Herdman and Mrs. Herdman will sympathise deeply with them in the great grief they are at present suffering through the death in action of their only son, George Andrew Herdman. The young officer was educated at Clifton College, and was a scholar of Trinity College, Cambridge. He entered Clifton College with a mathematical scholarship, was head of his house at Clifton, came out top of the school in physics and chemistry, and won an entrance scholarship at Trinity College, Cambridge, in December, 1913. He early showed a wide and keen interest in scientific problems, and in 1914 went out to Australia with the British Association. On returning, he immediately volunteered for active service, and

joined the Cambridge O.T.C. in October, 1914, was gazetted to the Liverpool Regiment in January, 1915, proceeded to the front in the following August, and, after seeing much hard service, was killed in action by a shell-burst whilst gallantly leading in a charge at the battle of the Somme on July 1 last, aged twenty years. The academic career of George A. Herdman was brilliant, but only those scientific friends who knew him personally were able to appreciate his originality of outlook and scientific independence of spirit, and to look forward to the development of a great career, which has been so untimely cut short by the cruel fate of war. Although his university career was only opening when the call to arms came, he was already deeply interested in several original problems, and had been taking physical observations on sea-water at Port Erin Marine Biological Station and on the west coast of Scotland during vacations for several years, as also on the voyage to Australia. He had recently worked assiduously and successfully with Prof. Benjamin Moore upon biochemical problems in nutrition of marine animals and plants, and questions in the physics and chemistry of photosynthesis, and he was joint author of two papers from the Port Erin Laboratory partly recording these observations: (1) "The Nutrition and Metabolism of Marine Animals: the Effects in the Lobster of Prolonged Abstention from Food in Captivity," and (2) "Seasonal Variations in the Reaction of Sea-water in relation to the Activities of Vegetable and Animal Plankton" (Trans. Biol. Soc., Liverpool, 1914 and 1915). While science deplores the early loss of such a promising young votary, those who knew him will agree that he himself would have gloried in the splendid victory won in the charge in which he fell, and counted his personal sacrifice as nothing for the honour of the cause.

It is with great regret that we record the death of Lieut. Arthur Poynting, who was killed in action in France on July 25. Lieut. Poynting, who was thirty-three years of age, was the only son of the late Prof. J. H. Poynting, F.R.S. After a four-year course in civil engineering, he graduated as B.Sc. of Birmingham University in 1905. On leaving the University he entered the service of the Midland Railway Co., being engaged for a short time at Derby, and afterwards on the construction of Heysham Harbour. For a thesis on his work at Heysham he was awarded the degree of M.Sc. in 1909, and in the same year he was elected an associate member of the Institution of Mechanical Engineers. In 1910 he became assistant-engineer at the London and St. Katharine Docks, and a year later was transferred to the Port of London Authority as assistant to the chief engineer, by whom he was regarded as a man of exceptional ability, with a first-class knowledge of engineering, and, in addition, a special aptitude for the legal aspects of his profession. In his university days he was an enthusiastic Volunteer, and on the outbreak of the present war he obtained a commission in the 6th (Service) Battalion of the Royal Warwickshire Regiment, going to the front early in 1915. At the time of his death he was in command of a machine-gun section, and was shot by a sniper, being killed instantaneously. Energetic and efficient in his work, modest and kindly in his bearing, steadfast of purpose, he was indeed a very gentle, perfect knight.

LIEUT-COL. A. ST. HILL GIBBONS, who has been killed in action, was well known as an African explorer. During the 'nineties he and the men who were associated with him in his travels covered more than 20,000 miles beyond the reach of railways, mainly in remote parts of the continent. On two expeditions in 1895–6 and 1898–1900 he thoroughly explored and mapped Barotseland and other parts of the Upper Zambezi basin, tracing the Zambezi to its most remote source, and providing valuable information about the navigability of the river, the resources of the country, and the customs of its inhabitants. His routes in this region covered at least 8000 miles. His maps were based on numerous astronomical observations, as well as careful compass surveys, and the late Mr. E. G. Ravenstein formed a high opinion of their accuracy. On his second expedition, Col. Gibbons, after completing his work in Barotseland, followed the Congo-Zambezi watershed towards Lake Tanganyika, and then, striking north, made his way to the Nile Valley. Ewart Grogan was the first traveller to complete the transcontinental journey from south to north; Col. Gibbons was a close second. He lectured more than once before the Royal Geographical Society, and in 1906 was awarded by the society the Gill Memorial. After serving through the South African War, Col. Gibbons settled in northern Rhodesia, and took an active interest in the development of that territory, delivering a lecture on its resources and prospects before the Royal Colonial Institute only a few months before the outbreak of the present war.

WE regret to learn of the death, in action, on July 14, of Second Lieut. C. M. Selbie, formerly assistant-naturalist in the National Museum, Dublin. He enlisted as a private in the Royal Scots, and in January, 1915, he received a commission as second lieutenant in the Scottish Rifles, and had been at the front since November. During the two years that Lieut. Selbie spent in the National Museum of Ireland he devoted himself with energy and enthusiasm to the collections of the Myriapoda and Crustacea. He rearranged the exhibition series and also undertook to name a portion of the collections of Crustacea procured on the west coast of Ireland during the Fishery Survey of the Department of Agriculture. The following is a list of the more important notes and papers published by him:—"A New Variety of *Polydesmus coriaceus*, Porat, and Note on a Centipede Monstrosity" (*Annals and Magazine of Natural History*); "Some New Irish Myriapods" (*Irish Naturalist*); "New Records of Irish Myriapods" (*Irish Naturalist*); "The Decapoda Reptantia of the Coasts of Ireland," part i., "Palinura, Astacura, and Anomura (except Paguridea)" (Fisheries, Ireland, Sci. Invest.). In addition, he had prepared but left unpublished "The Paguridea of the Coasts of Ireland."

BY the deaths of Prof. Johannes Ranke, of the University of Munich, and of Prof. Gustav Schwalbe, of the University of Strasburg, Germany has lost two of her most renowned students of the human body. Both died full of years and honours. Their careers were remarkably alike. Ranke, who was born in 1836, did his first research on tetanus, then devoted himself to physiology, and, finally, in the early eighties, took up the study of physical anthropology, and made many and important contributions to our knowledge of that subject. For many years he was editor-in-chief of the *Archiv für Anthropologie*. Schwalbe, somewhat Ranke's junior—he was born in 1844—did his first research on Infusoria, then devoted himself to the study of the microscopic structure of tissues, his chief work being an elaborate and accurate investigation of the finer structure of the sense organs. He taught and researched at Bonn, Amsterdam, Halle, Freiburg, Jena, and Königsberg, being ultimately called to the chair of anatomy in Strasburg in 1883, where he laboured for thirty-six years. He was well known and much respected by anatomists in every country.

The work by which he is best known, his researches into the nature of fossil apes and men, he began relatively late in life. At the end of last century he had accumulated such masses of observation dealing with the anatomical evidence bearing on the origin of man that he founded and issued a journal—the *Zeitschrift für Morphologie und Anthropologie*—for the publication of papers dealing with the evolution of the higher mammals.

AMONG the promising young geologists who have given their lives for their country we regret to note the name of Lieut. Richard Roy Lewer, King's Royal Rifle Corps. He died on July 21 of wounds received a few days previously, at the age of twenty-six. He was the elder son of Mr. H. W. Lewer, of Priors, Loughton, Essex, and was educated at Denstone College, and afterwards at Wren's. On the outbreak of war he was carrying on geological exploration at Calgary, but at once returned to England to take up military duties, and was gazetted second lieutenant on September 24, 1914, and lieutenant on February 22, 1915. He was elected a fellow of the Geological Society in 1911, and joined the Geologists' Association in 1914. His principal geological work had consisted in professional oil exploration, which he had carried out in Burma, Russia, Asia, and Western Canada.

THE death is announced, at the age of sixty-nine years, of Mr. Morton A. Smale, for many years dean of the Royal Dental Hospital, examiner in dental surgery at the Royal College of Surgeons of England, and joint author of "Injuries and Diseases of the Teeth."

AT the annual meeting of the British Pharmaceutical Conference, held on July 12, the president (Dr. David Hooper) devoted his address chiefly to an account of the drug resources of India and the Colonies. India is rich in drugs; our ancestors long ago sailed thither to fetch "spices, precious stones, and drugges for the Poticaries." Amongst the products to which attention was directed are cinchona, senna, strychnine, opium, turpentine, and thymol, not to mention frankincense and myrrh, which are still sold from the godowns of Bombay. Thousands of acres of cinchona are now grown near Darjeeling and in the Nilgiri Hills, and this is noted as "a grand result in acclimatisation," due to the pioneer work of the late Sir Clements Markham. Indian henbane has been found to give a high yield of mydriatic alkaloids, which are now becoming very valuable. Cantharidin, too, is furnished in high proportion by Indian species of Mylabris. In the Malay States ipecacuanha is successfully cultivated, whilst aloes, buchu, belladonna, and monsonia are exported from South Africa. Coriander and caraway are cultivated by farmers' wives in the latter country for the sake of pin-money, and it is suggested that this example might be followed here as an inducement to grow medicinal herbs.

M. CHAMBRELENT has studied statistically the subject of still-births and deaths of infants within three days of birth in France. He finds that the annual mortality from this cause is 4 per cent. of births, that it is much greater in the towns than in the country, and that it is higher the more populous the town. This difference between town and country he considers to be due to the less hygienic conditions obtaining in the towns, to alcoholism, and to chronic maladies, particularly syphilis and tuberculosis, which are more prevalent in towns than in the country. The male sex is more affected by still-birth than the female sex. It is particularly at birth and the few days following birth that this mortality among boys is so marked, and to a considerable degree it is preventable. Illegitimacy, as might be expected, considerably augments this mortality. The older the mother, also, the greater the mortality, while it is much higher at the first pregnancy than in subsequent pregnancies. This mortality is a factor which is by no means negligible in bringing about the depopulation of France (*Revue scientifique*, July 1–8, 1916, p. 391).

THE *Indian Journal of Medical Research* for April (vol. iii., No. 4) contains a number of papers on bacteriology, parasitology, and public health. Capt. Morison discusses the dose of alum necessary for the purification of water by precipitation. He finds that the best dose of alum for the perfect clarification of a soft water is obtained by adding half the equivalent weight of alum necessary to react completely with the alkalinity calculated as calcium carbonate. For a hard water the same rule holds good; but an equally good clarification can be obtained by the use of a smaller dose and a mechanical filter. A watery solution of hæmatoxylin gives a reddish colour when the correct dose has been given.

IN second series, part ii., vol. xvi., of the Journal of the Academy of Natural Sciences, Philadelphia, Mr. C. B. Moore presents an elaborate memoir on the exploration of aboriginal sites in the Tennessee River valley. The report would have been more valuable if it had been accompanied by a summary and some attempt to assign the remains to a particular tribe or group of tribes; but it contains abundant materials for a study of Indian mortuary customs. The district has suffered much from the depredations of curio-hunters, and the trade of "faking" flint implements seems to be a thriving one. The finest thing found is a splendid native pipe, cut in Catlinite or some similar red stone, representing a figure bent on one knee, the bowl and place for the mouthpiece being in the back of the carving. It would be difficult to exaggerate the importance of this admirable specimen, which may be regarded as one of the best examples of the art of the aborigines. He also found specimens of a reel-shaped decoration in copper, which seems to have served as a pendant or breast ornament. Only one other specimen of this type appears to be in existence. We have also the record of the first discovery of cowrie shells in an aboriginal mound. The date and mode of their introduction are questions of some difficulty, and Dr. W. H. Dall, writing to the author, says:—"Your cowries may have come off one of Columbus's own ships!"

IN vol. lxiv., No. 3322, of the Journal of the Royal Society of Arts, Sirdar Daljit Singh, of the India Council, gives a good account of the Sikhs. The sect at present numbers about five millions. It is well to have a description by an expert of the remarkable rite of *pahul*, or initiation. An iron vessel is brought into the assemblage, in which a mixture of water and sugar is placed. This is stirred with the point of a sword while the Japji and a collection of sayings of Guru Govind, who died a martyr in the time of the Emperor Aurangzeb, are recited. Some of the mixture is poured over the heads of the candidates for initiation, and the rest is drunk. The Sirdar rightly directs attention to the fact that Sikhism is a literary religion, and to the beauties of the Granth, or Scripture, of the sect. He also pays a well-deserved tribute to the loyalty and bravery of his brethren in the present war.

THE apparent ease with which the ancient Egyptians cut so stubborn a material as granite has long occupied the attention of Egyptologists. In part iii. of *Ancient*

Egypt for 1916 Mr. Somers Clarke describes how granite boulders from which building stone for the Aswan Dam was procured were dealt with by a party of quarrymen imported from Baveno, in North Italy. A vertical cut was made across the boulder, and it was split by wedges, each group containing two pairs of wedges side by side, driven into holes made with steel points. Dressing was done by means of a heavy metal tool, not unlike an adze, with its sharp end serrated. This was let fall vertically on the face of the stone, and by means of it all inequalities were removed. In the same connection, Mrs. Bertha Broadwood describes the method in use at the granite hills in Mysore. A line of small hollows is worked on the surface of the rock, a little straw is burnt over the hollows, a cupful of water is poured in, and the rock is thus split along the line of hollows to the depth of several inches. It may also be noticed that "feathers," or slips, of sheet metal are in Egypt placed on each side of the wedges to prevent them from crushing and grinding the edges of the grooves, which would waste the force used in merely enlarging the hole. These do not seem to have been used before Roman times.

A recent number of the *Bulletin of Entomological Research* (vol. vii., part 1) contains, among other papers, one by Dr. A. E. Cameron describing some experiments on the breeding of the mangold-fly. This student has already identified this common farm pest (*Pegomyia betae,* Curtis) as *P. hyoscyami,* Panz., the maggots of which often mine the leaves of Belladonna and other Solanaceæ. He now shows that flies reared from Belladonna will, in the absence of that plant, lay eggs on mangold leaves, in which the maggots complete their transformations. Curiously, flies reared from mangolds could not be induced to lay eggs on the closely allied sugar-beet. The dock-mining maggots belong to a distinct species of Pegomyia—*P. bicolor,* Wied—which will not lay eggs on either mangold or beet.

Another destructive dipteran crop pest of the British Islands, the cabbage-root maggot (*Phorbia brassicae*), which is also common and harmful in North America, is described at length by A. Gibson and R. C. Treherne in Bulletin 12 of the Canadian Department of Agriculture (Entomological Branch). The nearly allied *P. fusciceps* and the onion maggot (*Hylemyia antiqua*) are also dealt with. This bulletin is important for the careful records of generations through the yearly cycle and the variation in the numbers of eggs laid in the different months; also for some excellent photographs of the damage caused by the maggots to plants. It is noteworthy that the tarred discs for protecting cabbage plants from egg-laying by the fly are "widely used by market gardeners" in Canada, whereas suggestions to try them in these countries usually give rise to contemptuous amusement. The larvæ of *P. fusciceps* eat a great variety of plants, but occasionally they seek a change of diet by devouring locusts' eggs.

Publication 253 of the Queensland Geological Survey contains a description by R. J. Tillyard of some Mesozoic and Tertiary insects, mostly collected by the chief Government geologist, B. Dunstan, who contributes notes on the stratigraphical position. Most of the specimens come from a thin bed in the Coal Measures of Ipswich, South Queensland, for which a Triassic age is now claimed. These represent new genera of Blattoidea (1), Protorthoptera (2), Coleoptera (2), Mecoptera (1), Protohemiptera (1), and Hemiptera (1), besides a new and interesting archaic Odonate and the wing of a supposed Lepidopteron (Dunstania, n.g.), which, however, is perhaps more comparable with such a Dipteron as Psychoda. Triassic insects are little known, and we are glad to learn that this is only a foretaste of what may be expected from the Ipswich bed, in which the combination of archaic with more modern specialised types is particularly marked. From the Jurassic Wianamatta shales of St. Peter's, near Sydney, are some new genera of Blattoidea and Coleoptera, as well as a Protorthopteron, Mesotitan, with a forewing estimated to measure 9 in. by 3 in., recalling the huge Titanophasma of the Commentry Coal Measures, and affording yet another instance of the persistence of archaic types in the Australian fauna. The wing of a Neuropteron from the Tertiary shales of Goodna, Queensland, is referred to the Osmylidæ under the new generic name, Euporismites. The poor impressions of a dragon-fly larva from the Tertiary or Cretaceous shale of Duaringa scarcely warrant the introduction of a new generic name, even if it were ever wise to base a new genus on the larva alone.

The New South Wales Department of Mines is publishing a very elaborate monograph upon the geology and mineral resources of the southern coalfield, of which part i., dealing with the south coastal portion, by Mr. L. F. Harper, has just been issued in the form of a handsome volume of more than 400 pages with numerous illustrations. The Permo-Carboniferous formations within the area described are divided into four series, namely, (1) upper (Bulli-Newcastle) coal measures, (2) middle (East Maitland or Tomago) coal measures, (3) upper marine series, (4) lower (Clyde-Greta) coal measures. The upper marine series has not been found to contain any productive coal seams, and only the first-named series has hitherto been found to be of any value as a coal producer, the seams of the middle coal measures being of poor quality, whilst the areas of the lower coal measures are comparatively small, and the coal in them is of variable quality. The workable area of the upper coal measures is estimated at about 350 square miles; it contains seven coal horizons, of which the uppermost, or Bulli, coal seam is practically the sole source of coal supply. This seam appears to vary from 2 ft. to 9 ft. in thickness, and "rolls" and wash-outs appear to be numerous. The coal is of fair quality, but contains a rather high percentage of ash. The geology of the coal seams as exposed in the various collieries is described in much detail in the memoir.

The Transactions of the Geological Society of South Africa, vol. xviii. (1916), include a long paper by Mr. E. T. Mellor on the Upper Witwatersrand system, in which a case is made out for a deltaic origin of a large part of the strata. The quartzites, banded iron-ores, and other features interestingly resemble those of the Algonkian beds of North America. In the discussion on this paper (Proc., *ibid.*, p. 42) Prof. Schwarz regards the conglomeratic layers as incompatible with delta-flats, and as produced by temporary floods running from mountain-sides over the accumulations of normally dry plain-lands.

The term "peneplain" has undergone modification in meaning, and sometimes in spelling, since it was first introduced by Prof. W. M. Davis in 1889. In the *Geographical Review* for June, vol. i., No. 6, Prof. D. W. Johnson, of Columbia University, pleads for an extension, and at the same time precision, in its use. He suggests writing the word "peneplane" and using it for the penultimate stage in any cycle of erosion. The word "plane" he would use for the level erosion surface produced in the ultimate stage, and "plain," as generally used, for a low-relief region

of horizontal rocks. The question is, of course, a technical one for geographers to decide, and Prof. Johnson's short paper is worth consideration.

IN recent years the intercorrelation of meteorological data in different parts of the world has suggested important results which promise to have considerable economic value. Dr. G. T. Walker, Director-General of Observatories in India, has published a memorandum regarding the probable amount of monsoon rainfall in 1916 (Simla: Government Press; 8 annas). Data from South America, the Indian Ocean, and Ceylon, as well as from India, are briefly considered, and the result is to lead Dr. Walker to suggest that the outlook for the general monsoon rainfall of India is on the whole unfavourable this year, and that the rainfall is likely to be in slight or moderate defect, at any rate in the earlier part of the season. The deficiency is likely to be most marked in north-west India, while conditions appear to be favourable in Lower Burma, Assam, Malabar, and south-east Madras. Forecasting of this nature is still in its infancy, but Dr. Walker's attempt is most interesting, and promises to grow in value year by year.

THE August "Catalogue of Books in Standard Literature" of Mr. F. Edwards, High Street, Marylebone, contains many works dealing with general natural history, botany, conchology, ornithology, mammalia, entomology, and ichthyology.

OUR ASTRONOMICAL COLUMN.

THE AUGUST METEORS.—Mr. Denning writes:—"There is every indication that the Perseid display of 1916 will be of rather unusual activity. The shower was quite rich on July 31, August 1 and 5, and evidently increasing. Some fine meteors were observed, and especially on July 26, 10h. 7m., August 2, 11h. 41m., August 3, 9h. 44m., and August 5, 9h. 14m. That on the latter date was a fireball, and it formed a brilliant spectacle as seen from Bristol, falling from Cygnus to Ophiuchus.

"The maximum of the shower will probably be attained on Friday, August 11, but there will be many meteors visible also on August 12. The display is one noted for its long duration, but the really active phase of the phenomenon is included within one or two nights.

"The average height of the Perseids is from 81 to 53 miles, and their velocity 38 miles per second. Their flights are directed from the north-eastern sky, the radiant at $44^\circ+57^\circ$ in Perseus being situated in that quarter of the heavens.

"The time of maximum should be carefully determined, and the horary numbers ascertained during the nights of August 11 and 12. The moon, however, being very nearly full, will prevent many of the smaller meteors being observed.

"The more brilliant objects should be especially noted, and their paths among the stars recorded as accurately as possible. The phosphorescent streaks which are generated along the courses enable the direction to be exactly registered on a star map or celestial globe. These Perseids furnish many fine meteors, and fireballs frequently occur among them. In the case of one of the streaks or afterglows remaining visible for several minutes, its drift amongst the neighbouring stars should be noted as precisely as possible."

JULY METEORS.—Mr. Denning writes:—"The very fine summer weather prevailing during the latter half of July enabled a large number of observations to be obtained. The first Perseids were detected on July 8, but the shower was not very prominent until July 3[1] and August 1. A splendid meteor was seen from i[t] or possibly from a contemporary display in the sam[e] region, on July 26, at 10h. 7m.

"There was a very active radiant of slow and bril[liant] meteors from the point at about $302^\circ-8^\circ$ fro[m] July 7 to the end of the month, and it was still visibl[e] on August 2. Twenty of its meteors were recorded a[t] Bristol, and many others were seen by Mrs. Fiam[-]metta Wilson at Totteridge. Six of the meteors wer[e] doubly observed, and their real paths have been com[-]puted.

"During the last week of the month the Aquari[d] shower came actively into play from $338^\circ-11^\circ$. Thi[s] stream has been only scantily visible in the past fe[w] years, but its return in 1916 showed it to have re[-]covered its old-time prominence. The chief radiant[s] seen were:—

	° °		
July 31	31 + 53½	8 ↕'s	Perseids
August 1	31 + 55	10 ↕'s	,,
July 25–29	36 + 47	7 ↕'s	θ Perseids
July 7–August 2	302 − 8	20 ↕'s	α Capricornid[s]
July 23–August 1 ...	302 + 24	6 ↕'s	Sagittids
July 23–29	333 + 58	7 ↕'s	ζ Cepheids
July 23–August 1 ...	338 − 11	12 ↕'s	δ Aquarids

"The more interesting real paths were:—

July	G.M.T. h.	m.	Mags.	Height at first. Miles	Height at end. Miles	Path. Miles	Velocity per sec. Miles	Radiant Point ° °
8	11	59	> ♃ − ♀	77	51	121	32	22 + 24
19	10	18½	1 − 1	76	51	60	26	301 − 8
25	10	13½	2 − 2	89	55	40	48	334 + 57
,,	11	14	> 1 − > ♃	70	41	61	25	302 − 8½
,,	11	32	> ♀ − 2 + ♀	62	44	37	18	302 − 9
,,	11	39	2 − ♂	61	41	46	23	301 − 10
26	10	7	> ♃ − > ♀	86	49	91	37	35 + 51
27	10	34½	> 1 − > 1	69	60	52	37	338 − 14
,,	10	15½	3 − 2	59	51	18	18	301 − 9
,,	10	45½	4 − 3	69	43	36	54	332 + 25
29	10	3	> 1 − > ♃	78	55	49	24	303 − 7
,,	10	10½	2 − > 1	84	58	118	48	5 + 13
31	10	39	5 − 4	61	55	80	40	342 − 16

"Observers—Mrs. Fiammetta Wilson, Totteridge; Miss A. Grace Cook, Stowmarket; and the writer, Bristol."

A SUN-SPOT IN HIGH LATITUDE.—In the course of the heliographic work at Greenwich, it has been found that photographs of the sun taken at the Cape Observatory on December 26, 1915, show a small, but unmistakable, spot in the extraordinary latitude 59·6° S. This is considerably above that of the spot observed by Peters in 1846, the latitude of which was 50·4°, and is apparently the highest yet recorded (Journal B.A.A., vol. xxvi., p. 292).

LOWEST EFFECTIVE POWER OF A TELESCOPE.—It ha[s] usually been considered that the lowest power whic[h] can be employed on a telescope, while retaining ful[l] illumination, is one of five to each inch of aperture, this estimate being based on the assumption that th[e] average diameter of the pupil of the eye is one-fift[h] of an inch. Mr. W. H. Steavenson has investigate[d] the diameter of the pupil by flashlight photography and has found that while one-fifth of an inch may b[e] a fair estimate of the aperture in daylight, one-thir[d] of an inch is much nearer the aperture at night. A[n] interesting application of this result has been mad[e] by Naval Instructor M. A. Ainslie, R.N., in connec[-]tion with the 72-in. mirror of the Rosse reflector, no[w] included in the collections at the Science Museum. The "original" eyepiece of the great telescope ha[s] been found to have an equivalent focal length o[f] 7·7 in., giving a magnifying power of 84 and a[n] emergent pencil of 0·855 in. diameter. It follows tha[t] the effective aperture of the speculum, when thi[s]

eyepiece was used, would be only 25 in., or approximately equal in light-gathering power to a refractor of 20-in. aperture. A power not less than 216 would be necessary to give the full benefit of the large mirror. Although the eyepiece in question was not the only one employed, it may be important to take account of the fact that some of the observations at Parsonstown were not made with the full aperture of the telescope (Journ. B.A.A., vol. xxvi., p. 302).

VENTILATION AND METABOLISM.

THE New York State Commission on Ventilation has issued an outline statement of the work done in 1915. In the first report the Commission supported the view of the English physiologists, that the principal factors which make for comfort are temperature humidity and air movement, and that the effects of poor ventilation cannot be explained by the presence of volatile organic poisons in the air or any chemical change in the atmosphere. Even slight differences in temperature produce characteristic physiological responses in the body, affecting the output of physical work and likewise the inclination to do mental work. "In only one respect did the chemical quality of the air breathed show any characteristic effect on the body mechanism, this effect appearing in the slightly diminished appetite for food in a stale, unventilated atmosphere."

The Commission has now sought to find what quality of the stale used air has this effect. Is it the odour present? the increased CO_2? or what? Artificial body odours and excess of CO_2 have been introduced into a room ventilated with fresh air, but these have not produced the effect on the appetite. We do not believe that the Commission has ever properly eliminated the physical conditions. In their experiments they arranged that the temperature (wet and dry bulb) should be kept the same in the ventilated as in the stale-air chamber, and in the latter they placed a table fan to blow air upon the subjects, in order to imitate the current of air which circulated in the chamber ventilated with fresh air. There is no proof that the fan had this effect. It may not have ventilated the clothes of the subjects as effectually as the current of air did in the fresh-air chamber. We would suggest that the rate of cooling be measured with the katathermometer. Until this is done we cannot accept the view that the diminished appetite is due to any chemical alteration of the stale atmosphere. It seems more likely to be caused by a diminution in metabolism resulting from a lessened rate of cooling of the body surface.

The Commission says that for extreme mental concentration, involving an almost entire absence of physical exertion, a temperature of 75° at 50 per cent. relative humidity was preferable to 68° at the same humidity, whereas for tasks involving greater motor effort, such as typewriting, the cooler temperature was coincident with the greater output. Here again data are wanted as to rate of cooling. Was the atmosphere a still one? In this country 63° F. is regarded as a suitable temperature, but the comfort is far more a question of rate of cooling than of temperature. We would point out that mental concentration which demands an entire absence of physical exertion and so warm an atmosphere tells against the health of the body; the metabolism is greatly reduced, and with it the appetite; the digestive organs miss the massage due to bodily exercise and deep breathing; the circulation is not made vigorous by the pumping action of the skeletal muscles and those of respiration; and the lungs are but little expanded by the shallow breathing. Daily open-air exercise is essential to compensate for such intense mental application if the health is to be maintained. Such work, together with high feeding, alcoholic pick-me-ups, and amusements taken in hot atmospheres, leads to the bodily flabbiness and middle-age degeneration of the business man. The scholar requires his "constitutional" or else he will become hypochondriacal.

The Commission has examined the conditions of the nasal mucous membrane in hot and cold atmospheres, and generally confirms conclusions reached by the reviewer (*cf. Lancet*, May 10, 1913). In the majority of subjects examined the reaction from heat is one of increased swelling, moisture, and redness, and the reverse from cold. Air blown upon the face by fans greatly modifies the effect. On going from the cold to the hot room with fans there is a decrease in the size of the inferior turbinates and in the amount of moisture. The characteristic change on passing from the hot to the cold condition with fans is an increase in the turbinates and secretion. The Commission reports that laundry workers show a high percentage of cases of atrophic rhinitis, the result of working in hot humid atmospheres. The changes of the nasal membrane produced by environment must materially affect the incidence of infection by "colds." This subject is dealt with by the reviewer in an article published in the *British Medical Journal* for April 15, 1916.

Mr. Palmer, the chief of the investigating staff of the Commission, has fashioned a new sampling apparatus for the determination of aerial dust. Air is drawn, by means of an electric-driven fan, through a U-tube containing some water. The water is thrown into a spray formation in a conical glass vessel attached to the U-tube, and the air is washed of its suspended dust as it passes through the water shower. One hundred cubic feet of air can be put through in thirty minutes. The water can be evaporated and the dust weighed, or the dust can be estimated by the turbidity of the water against a set of standards, or the particles of dust—in a measured quantity of the water—counted under the microscope. The pernicious effect of dust on the lung is not properly realised by the public. Dust containing free silica is the most potent cause of phthisis prevalent in miners, granite and flint workers, etc. The motor-cars stir up clouds of dust from roads metalled with flint and granite. People dislike the dust on their clothes, but do not realise the damage it causes to their lungs. All dusts diminish the efficiency of the lungs and lead to lessened expansion and shortened breath—the asthma of dusty occupations.

LEONARD HILL.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual meeting of the American Philosophical Society was held on April 13–15, during which nearly fifty papers were presented on a large variety of topics. The address of welcome was delivered by Dr. W. W. Keen, the president, who, with the vice-presidents, Dr. W. B. Scott and Prof. E. C. Pickering, presided at the various meetings.

We are able, from the material which the secretary, Prof. A. W. Goodspeed, has sent us from Philadelphia, to give brief abstracts of some of the papers which were read.

Dr. R. F. Bacon, "The Work of the Mellon Institute in its Relations to the Industries and to the Universities":—

The first industrial fellowship at the Mellon Institute was founded through a grant from a baking company which desired to improve its product. The sum of money given was used, as has been all

the money which has been subscribed to industrial fellowships, with the exception of small sums for the purchase of very special apparatus, to secure the services of a man who had shown a gift for research to devote all his time to certain problems connected with the baking industry. During the five years which have elapsed since the establishment of the first fellowship forty-seven distinct business organisations have endowed one hundred and five one-year fellowships. The total amount of money contributed to the institute for the five years ending March 1, 1916, was 72,000*l*. In addition to this sum 4260*l*. was awarded in bonuses to fellows for the successful completion of problems. During the five years the institute itself expended about 35,000*l*. Besides this amount, the building and permanent equipment of the institute represent an investment of between 60,000*l*. and 70,000*l*. That the results obtained under the industrial fellowship system of the Mellon Institute have justified the expenditure of these sums of money has been shown by the fact that during the first four years seven out of each ten problems assigned to the institute for study were solved to the satisfaction of the donors. A large percentage of the fellowships were renewed, showing the confidence which industrialists have in the institute. Twenty-five patents have been granted to the holders of fellowships, and there are as many more pending. Above all, some twenty new processes developed in the institute are now in actual operation on commercial scales.

Dr. G. F. Atkinson, "The F_2 Generations, and Back- and Inter-crosses of the F_1 Hybrids between *Œnothera nutans* and *pycnocarpa*":—

The result of the observations shows that in the F_1 generation from a cross between two feral, non-mutating species quadruplet hybrids appear in the F_1 generation; one is a blend and self-sterile, but its pollen and egg cells are fertile; two of the degregates are fixed types and breed true, while the fourth hybrid (third segregate) appears to split in the second generation. The back- and inter-crosses show either striking examples of patrocliny, or splitting into two types in some cases, into three types in other cases. But no new types (with a single exception) appear; they all conform to one or other of the six types, the primary parental types, or one or more of the F_1 hybrid types. The single exception is a mutant of the dwarf *gracilis* type.

Prof. J. M. Coulter, "Inheritance through Spores":—

The current work in plant genetics suggests the question of the most favourable material. If sexual forms are desirable, it seems obvious that the most primitive should be included in experimental material, since in such forms the sex act is not involved with other structures, the origin of the sexual cells is observable, and the whole situation lends itself to more complete control and analysis. The sexual cells, however, are genetically related to spores, so that the origin of spores and their behaviour in reproduction are preliminary to the origin of gametes and sexual reproduction. Reproduction by spores, therefore, is a field rich in experimental possibilities. Analysis of the conditions of spore formation furnishes a clue to the additional conditions necessary for gamete formation; experimental modification of the "germ plasm" is more simple and definite than in complex material; and breeding from spores with essentially pure lines is especially favourable for securing more definite data in reference to the possibilities of variation and inheritance.

Prof. W. J. V. Osterhout, "The Dynamics of Antagonism":—

If two toxic substances antagonise each other this is called action antagonism. An accurate measure of antagonism is afforded by determining the electrical resistance of living tissues. Toxic substances cause a fall of resistance, but if in a mixture of two such substances resistance falls less rapidly, it is evident that this is due to antagonism. In the case of the common kelp, Laminaria, NaCl causes a fall of resistance, while $CaCl_2$ causes a rise, followed by a fall, of resistance. In mixtures of NaCl and $CaCl_2$ the resistance rises and then falls; by using the right proportions the fall may be made very gradual. These facts may be explained by assuming that the resistance is due to a substance the production of which is accelerated by $CaCl_2$, while its decomposition is checked by a compound formed by the union of both NaCl and $CaCl_2$ with a substance in the protoplasm. This throws new light on the manner in which salts act in preserving life. It has been found that the electrical resistance is a very delicate and accurate indicator of the vitality of protoplasm, since any kind of injury is at once indicated by a fall of resistance. This permits a quantitative meaning to be given to such terms as vitality, injury, recovery, and death. The mechanism by which changes in resistance are produced by salts is therefore of great importance. The facts here presented give a new insight into this mechanism.

Prof. F. Ehrenfeld, "Jointing as a Fundamental Factor in the Degradation of the Lithosphere":—

In most text-books the question of land surface levelling or degradation is considered more from the view-point of the atmospheric or other surface cause than from that of the construction of the solid portions of the earth itself. This is a somewhat mistaken view to take of the case, as the stony mass of the earth has been shown by many geologists to be subject to a constant fracturing, or jointing, which shows itself in various ways, such as influence on river drainage, repeated groups of islands, bays along sea coasts, and in certain types of volcanic and earthquake appearances. The paper discussed these and also the subject of marine planation to produce a lowering of the land below sea-level. Illustrations of such marine action were shown from the Maine coast and also from the forms and positions of some of the Atlantic Ocean islands. This subject of the action of the sea to produce a general levelling, though much discussed some decades ago, has been neglected by many modern students, but is now becoming prominent under newer ideas, and this paper is in part a study of jointing in the mass of the lands to assist in such action and hasten continental land levelling and destruction by creating in the rock mass through joints great lines of weakness which, under the attack of both the atmosphere and the sea, compel the falling apart of the land. The author proposed a "law of joints" in which the controlling influence of joint lines was more definitely stated.

Prof. W. M. Davis, "Sinking Islands *versus* a Rising Ocean in the Coral-Reef Problem":—

Since Darwin's voyage in the *Beagle*, eighty years ago, nearly all geologists who adopted his theory of coral reefs accepted also his postulate that the reef-bearing islands have subsided with the subsiding ocean bottom. In later years, and largely under the leadership of Suess and Penck, the possible variation of ocean level around fixed islands has been emphasised. When it is seen that a rise of the ocean surface around still-standing islands would produce all the conditions that arise from Darwin's postulate of subsiding islands in an ocean of constant level, search should be made for some means of evaluating these two alternatives. The result of such a search shows that the theory of a changing ocean involves many extravagant complications which have not been sufficiently considered by those who accepted it; while the theory of subsiding islands is relatively simple and economical. Darwin's

original theory is to be preferred on those grounds.

Prof. J. P. Iddings, "The Petrology of some South Sea Islands and its Significance":—

The islands of Tahiti, Moorea, Huaheine, Raiatea, Tahaa, Bora Bora, of the Society group, and Hiva-oa and Nukahiva, of the Marquesas, were visited in order to ascertain whether the volcanic rocks composing them are of such a character that they support the theory of isostacy, which demands that the deep portions of the earth's crust, or the lithosphere, under the Pacific Ocean should consist of heavier material than that underlying the continent of North America. It was found that the volcanic rocks of these islands are noticeably heavier on the average than the igneous rocks occurring in various parts of the American continent. Each of the islands visited was found to be an extinct basaltic volcano, considerably eroded, and partly submerged beneath the sea.

Prof. J. J. Stevenson, "Coal Formation":—

The doctrine that the fossil fuels from peat to anthracite are a continuous series has been the subject of renewed discussion within recent years. The author felt compelled to make serious investigation to free himself from doubts aroused by the statements of some authors. The general study has advanced so far as to justify presentation of the first part of his monograph. The plan adopted is to discuss the fuels in order of age, beginning with peat and closing with the Palæozoic coals. The first part considers peat and the Tertiary coals; the second will consider the Mesozoic and the Palæozoic coals. The author hopes to make evident the inherent probability of the doctrine that, in spite of difference in plant materials, the coals throughout form a connected series, not merely in mode of accumulation, but also in physical structure and in chemical composition.

Mr. G. Scatchard and Prof. M. T. Bogert, "A New and very Sensitive Indicator for Acidimetry and Alkalimetry and for Determining Hydrogen Ion Concentrations between the limits of 6 and 8 on the Sorensen Scale":—

The authors have discovered that dinitrobenzoylene urea is an unusually sensitive indicator, and one which can be prepared easily, in any desired amount, from anthranilic acid. It changes from colourless to greenish-yellow with a change in hydrogen ion concentration from 10^{-6} to 10^{-8}, the development of the colour following regularly the decreasing concentration of hydrogen ion. It is very little affected by neutral salts or proteins, and not at all by the ordinary biological preservatives, chloroform and toluene. The colour does not fade perceptibly in two days, and does so but very slightly in a week. It therefore promises to be very useful in the measurement of hydrogen ion concentration of biological or other liquids in this important range, for which the previously known indicators are not very satisfactory.

Dr. F. W. Clarke, "The Inorganic Constituents of Marine Invertebrates":—

It is a commonplace of geology that many limestones are formed from the remains of marine animals, such as corals, molluscs, crinoids, etc. Some of these limestones are magnesian, some are phosphatic, and others are of the ordinary type, consisting chiefly of calcium carbonate. They were originally deposited at the bottom of the sea, and their composition depends upon the composition of the organisms which formed them. The present investigation has for its purpose to determine what each group of organisms contributes to the sediments; and in order to answer this question nearly 250 analyses have been made of the shells or skeletons of marine invertebrates, covering a range from the Foraminifera up to the Crustacea, and including also the coralline algæ. It was already well known that corals and molluscan shells were composed almost entirely of calcium carbonate, and that fact has been verified. The shells of one group of brachiopods, however, consist largely of calcium phosphate, and that substance is also abundant in the Crustacea. These animals, and also vertebrate skeletons, contribute phosphates to the sediments. The Foraminifera, Alcyonaria, sea-fans, echinoderms, and calcareous algæ, with some minor groups or organisms, contain much magnesia, and therefore aid in the formation of magnesian limestones. Curiously enough, the amount of magnesium carbonate in any series of organisms varies with the temperature of the water in which the creatures lived, being small in cold and large in warm waters. A sea-urchin from Greenland, for example, contained 6 per cent. of magnesium carbonate, and one from near the equator contained more than 13 per cent. In certain algæ from the West Indies 25 per cent. was found. Furthermore, some organisms have their calcium carbonate in the form of aragonite, and others consist of calcite. The aragonitic organisms are all non-magnesian, while the magnesian forms are all calcitic. The data obtained in this investigation have been applied to the study of coral reefs, which owe their composition to all the creatures living upon them, and not to the corals alone. In fact, the corals are often of less importance than their associates.

Dr. W. Duane, "Some Relations between Matter and Radiation":—

It is known that the impacts of atoms of electricity against atoms of ordinary matter produce radiation. Mr. Hunt, Dr. Webster, and the author have been investigating the relations between the energy of the atom of electricity and the frequency of the radiation it produces. The most striking facts discovered are that in the case of the so-called *general radiation* the energy required is strictly proportional to that frequency, and in the case of the so-called *characteristic radiation* the energy required is larger than in the preceding case and not always proportional to the frequency. High-frequency vibrations are associated with the central parts of an atom of matter, in which the electromagnetic field is very strong. In order to reach a point in an atom of matter where a given frequency of vibration is produced the atom of electricity must have at least enough energy to overcome a certain force of repulsion acting between them. If we follow out the line of reasoning and apply Maxwell's distribution law and what has been called the fourth power law to the case of the atoms of electricity flying about in a hot body owing to its thermal agitation, we arrive at an equation for the distribution of energy in the spectrum that represents the facts with considerable precision. These laws discovered by experimental investigation have a practical bearing on X-ray phenomena also. They indicate what must be done in order to produce those very high-frequency radiations that hitherto have been obtained from radioactive substances only.

Dr. L. A. Bauer, "Relation between Changes in Solar Activity and the Earth's Magnetic Activity, 1902–14":—

No criterion of solar activity has been found to synchronise precisely with any quantity used as an index of the earth's magnetic activity. Thus, for example, the maximum magnetic activity in 1892 preceded the maximum sun-spot activity of that period by a year. So again the recent minimum magnetic activity of the earth seems to have occurred in 1912, whereas the minimum sun-spot activity did not take place until 1913, or a year later. Then the amount of magnetic activity is not necessarily commensurate with that of solar activity, whatever measure of the latter be used. When the comparisons between the solar data

and the magnetic data are made for intervals of less than a year—a month, for example—the lack of exact synchronism and the lack of proportionality between the two sets of changes become especially noticeable. Fortunately, beginning with 1905, we have a new set of figures, the values of the solar constant, determined with high precision at Mount Wilson, California, by Dr. Abbot. Remarkable fluctuations are shown in these values, amounting at times to 10 per cent. of the value. The present paper makes a comparison between the annual changes in the values of the solar constant for the period 1905 to 1914, with the irregularities in the annual changes of the earth's magnetic constant. It is found that the two sets of data, in general, show similar fluctuations. Also, a closer correspondence is found between these two sets of changes than between either set and that of sun-spot frequencies. In brief, the solar-constant values furnish another index of changes in solar activity which may be usefully studied in connection with minor fluctuations in the earth's magnetism.

Dr. W. Patten, "Co-operation as a Factor in Evolution":—

The purpose of this discussion is to show that co-operation, or the summation of power, is the creative and preservative agent in evolution, and that the summation of power depends on co-operation in the conveyance of power. Co-operation in the inner life of the individual is a pre-requisite to co-operation in its external life. The larger physical volume and organic power of the individual are the means by which it finds the larger sources of supplies and the better ways of cosmic and social co-operation. What we call "evil" is that which prevents, or destroys, co-operation. "Good" is that which perpetuates and improves co-operation. The "struggle for existence" is a struggle to find better ways of co-operation, and the "fittest" is the one that co-operates best. The same laws which prevail in the inner and outer life of animals and plants prevail in the social life of man. Man's social progress is measured by the degree to which he has extended the mutually profitable give-and-take of co-operative action beyond himself to the family, tribe, and State, and into the world of life at large. The chief agents of civilisation—language, commerce, science, literature, art, and religion—are the larger and more enduring instruments of conveyance, which better enable the part and the whole to avoid that which is "evil" and to find that which is "good," and which yields a larger surplus for "freedom."

Prof. G. H. Parker, "Types of Neuromuscular Mechanism in Sea-Anemones":—

In the origin of nerve and muscle the sea-anemone has been supposed to represent a step in which a nervous net of very primitive structure could throw into prolonged contraction the general musculature of the animal's body. An examination of the body of the sea-anemone shows that its muscular activities are of a much more diverse kind. They include, first, muscles that act under direct stimulation and without the intervention of nerves; secondly, muscles that are stimulated directly, as well as by nerves; thirdly, muscles that are stimulated only by nerves and exhibit in these circumstances profound tonic contractions; and, finally, muscles that react in the same reflex way that those in the higher animals do. This diversity of muscular response has not been fully appreciated by previous workers.

Prof. E. C. Pickering, "Determination of Stellar Magnitudes by Photography":—

An immense amount of work is being carried on by observatories all over the world in determining the photographic magnitudes of the stars. It is of the utmost importance that all these magnitudes should be reduced to the same scale. Accordingly, in April, 1909, an International Committee was appointed, with members from England, France, Germany, Holland, Russia, and the United States. This committee met in 1910 and 1913, and, after a most amicable discussion, agreed on a system in which all stars were to be referred to a standard sequence of stars near the North Pole. The magnitudes of the latter were determined at Harvard by Miss H. S. Leavitt by six different methods, using eleven different telescopes, having apertures from one-half to sixty inches. All gave accordant results, and were adopted by the committee. A simple method was found for transferring these magnitudes to stars in other parts of the sky, but here extraordinary sources of systematic errors presented themselves. For example, if two equal exposures were made on a plate, the second was found to give fainter images; if, by means of a small prism, exposures were made simultaneously with different apertures, the smaller aperture indicated a brighter magnitude than the larger when the stars were bright, and a fainter magnitude when they were faint. The colour equation was found to vary by different amounts, not only for different instruments, but for different magnitudes.

Miss A. J. Cannon, "A New Catalogue of Variable Stars":—

So great has been the increase in the number of variable stars that a new catalogue now being compiled contains 4641 stars, of which 3397, or nearly three-quarters of the whole, have been found at Harvard, and 1244 elsewhere, by astronomers in nearly all portions of the civilised world. The variable stars are divided into five classes, dependent upon the character of their variation in light. The periods vary from three hours to 698 days. Determination of the periods and light curves of these stars constitutes a large piece of work. Much has been done at Harvard in this field, and many observations have been furnished by other astronomers for such determinations. No more suitable place could be found for the preparation of this catalogue than the Harvard Observatory, for the rich library of a quarter of a million stellar photographs furnishes the only complete material in the world for the study of these stars during the last twenty-five years. By examining the past history of a star on these photographs, the investigator may far more readily find an answer to such perplexing questions as to whether a star is variable or constant, what is the length of the period, is the period changeable, what is the colour or the spectrum of the star, than by waiting months or years to accumulate additional observations.

During the morning of April 15 the following foreign members were elected:—Dr. F. D. Adams, F.R.S., of Montreal; Dr. W. L. Johannsen, of Copenhagen; and Dr. J. D. van der Waals, of Amsterdam.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE sum of 3000*l.* has been bequeathed to the Yale University School of Medicine by Mr. Norman B. Bayley.

PROF. J. J. VAN LOGHEM has been appointed to the newly founded chair of tropical hygiene in the University of Amsterdam.

DR. R. ARMSTRONG-JONES has resigned, as from September next, after twenty-three years' service, the medical superintendency of Claybury Asylum.

The Gladstone Memorial prize at the London School of Economics and Political Science has been awarded to Mr. Ramchandra Mahadev Joshi, of Bombay.

The sum of 10,000*l*. in Consols has been given by Mrs. Streatfeild, to be held in trust jointly by the Royal College of Physicians of London and the Royal College of Surgeons of England, for the promotion of research.

The programme for the session 1916–17 of the Department of Technology of the City and Guilds of London Institute has now been published by Mr. John Murray at the price of 9*d*. net. It contains the regulations for the registration, conduct, and inspection of classes, the examination of candidates in technological subjects, and for the award of teachers' certificates in manual training and domestic subjects. The syllabuses in the following subjects have been revised:—Gasfitting, silversmiths' work, goldsmiths' work, and jewelry, painters' and decorators' work, and heating and ventilating engineering. Other syllabuses have been redrafted, and these include:—Electrical installation work, typography, carpentry and joinery, brickwork, masonry, and plasterers' work.

Work has been begun upon the building of the Museum of the American Indian, at 155th Street and Broadway, New York, which is to house the ethnological collection made by Mr. George G. Heye during the last twenty-five years. It will be in charge of a group of trustees, of which Mr. Heye himself is chairman. The ground was given by Mr. Archer M. Huntington, and the cost of the building, amounting to 50,000*l*., has been subscribed by other friends of Mr. Heye. The collection will be supplemented by the working library of archæology which has been brought together by Prof. Marshall H. Saville, of Columbia University. In addition to Prof. Saville, Mr. George H. Pepper, who has spent much time among the Navajo and Hopi Indians, will be a member of the staff of the museum.

At the conference of presidents and other representatives of Canadian universities held at McGill University, Montreal, in May last, the following resolution was unanimously adopted:—"This conference is strongly of the opinion that, to strengthen the unity of the Empire, the universities of Great Britain should be urged to modify and increase their graduate facilities to meet the needs especially of students of the Dominion; and also, to effect this purpose, that a committee be appointed to correspond with the universities of Great Britain, and that the committee also correspond with the universities of France, with the object of increasing the number of students from Canadian colleges." The members of the committee are President Falconer, of Toronto University; Sir W. Peterson, president of McGill University; Abbé E. Chartier, of Laval University; and Dean Cappen, of Queen's University. The next conference will be held in Ottawa in 1917.

A copy of the prospectus of the university courses in the Manchester Municipal School of Technology for the session 1916–17 has been received. The school offers systematic training in the principles of science and art as applied to mechanical, electrical, and municipal and sanitary engineering; architecture and the building trades; the chemical industries; the textile industries; and photography and the printing crafts. It possesses extensive laboratories and workshops equipped with full-sized modern machinery, tools, and apparatus, including not only machines of the types now in general use, but also machines especially constructed for demonstration, experiment, and original research. Its work includes advanced study and research in science and technology; university courses in the faculty of technology, leading to degrees in applied science; and part-time day and evening courses for a great variety of workers. The present prospectus forms the first part of the calendar of the school, the other activities of which are to be described and explained in later parts of the calendar.

In his opening address to the vacation course of the Oxford School of Geography on August 3, Dr. J. Scott Keltie reviewed the progress of geography during the last half-century. This included, first, the additions to our knowledge by means of exploration; secondly, progress in the methods of dealing with such results; and thirdly, improvements in geographical education. No period, said Dr. Keltie, had been so prolific in exploration since the half-century following the discovery of America by Columbus. The two poles have been reached, and large additions made to our knowledge of polar regions. The unknown two-thirds of Africa have been provisionally mapped. Great areas of North America have been surveyed and occupied, and much of South America has been explored. The map of Asia has been largely reconstructed, the interior of Australia traversed in all directions, and much of Europe re-surveyed. Lastly, the science of oceanography has been created. Geographical research is now conducted on scientific lines, and the explorer of the future must be differently equipped from the pioneer of the past. Geographical education has made strides in universities and schools, but there is still a dearth of adequately trained teachers to do the subject justice.

The future of the British chemical industries is so closely bound up with the education of the technical chemist that it is not surprising to find this constantly discussed in the technical and daily Press. In the July Engineering Supplement of the *Times* Prof. F. G. Donnan deals with the relation of the engineer and the chemist from the point of view that it is necessary to bridge the gap which exists between our present chemical and engineering laboratories by "inter-linking" laboratories of chemical engineering. He pictures the young chemists and engineers who intend to enter the field of applied chemistry meeting here and learning to work together to the great benefit of the industries. Unfortunately, this development is hindered, if not prevented, by the British examination degree system, which, as Prof. Donnan truly observes, is even more powerful at the newer and supposedly modern universities than at Oxford and Cambridge. The only apparent remedy is for manufacturers to recruit their staff by taking men on the personal recommendation of the university professor, a course which the more enlightened firms have been following for some time. This involves, however, that the professor should have an accurate knowledge of the requirements of industry, so that he may not recommend the wrong type of man. Prof. Donnan lays great stress on the superiority of a training in physical chemistry as the only road to real applied chemistry, and condemns what he terms the molecule-juggling type of chemist usually turned out from the chemical laboratories of the universities and higher technical schools. The training in physical chemistry as sketched by Prof. Donnan appears to be open to the criticism of being too general and not yielding a product of sufficiently high calibre to act in any other capacity than as departmental under-manager in the works. It must not be forgotten that the industry needs also men with a real knowledge of chemistry, above all of organic chemistry, and, though the demand for such men is less than that for under-managers, they alone can act to recreate the industry.

It is within experience also that the plant constructed by the so-called chemical engineer, meaning the chemist with a knowledge of engineering, is likely to result in heavy repair costs. As Prof. Donnan truly indicates, what the industry wants is the association of specialists in both sciences, each understanding enough of the other's profession to enable them to work together with the greatest efficiency.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 24.—M. Ed. Perrier in the chair.—The president announced the death of Sir William Ramsay, foreign associate.—G. **Bigourdan**: The propagation of sound to a great distance. The distance at which the sound of firing at the front can be heard, given in a recent note as 250 kilometres, must be extended to 300 kilometres.—C. **Richet**: The time minimum in the psycho-physiological reaction to visual and aural stimulations. Remarking on a note by MM. J. Camus and Nepper (see below), the author agrees that the figures put forward by M. Lahy appear to be too low, and are probably affected by a systematic error.—M. **Petrovitch**: The relations of inequality between arithmetical and geometrical means.—M. **Mesnager**: The displacement of the points of a rectangular plate.—M. de **Broglie**: The K absorption band of the elements for the X-rays, from bromine to bismuth, and the emission of a Coolidge tube for very short wave-lengths. Measurements of the absorption band of elements—that is, indirectly the shortest line of the K group of their spectra—are given for twenty-four elements, ranging in atomic weight from bromine to thorium. A tungsten antikathode was used and the wave-lengths measured, decreasing regularly with the increase in the atomic weight, the only exception being the relative positions of iodine and tellurium.—Mlle. P. **Collet**: The working of galena employed as detectors in wireless telegraphy.—MM. **Massol** and **Faucon**: The absorption of ultra-violet radiations by the bromo-derivatives of methane. Experiments were made on bromine, carbon tetrabromide, tribromomethane, and dibromomethane. The characteristic band of bromine in solution was not found in any of the bromo-derivatives of methane. These compounds increase in transparency for ultra-violet light as the proportion of bromine they contain diminishes, and each bromine derivative is less transparent than the corresponding chlorine derivative, examined under the same conditions of concentration and thickness.—E. **Moles**: The density of hydrogen bromide. Contribution to the revision of the atomic weight of bromine. The mean of thirty-two determinations of the density of hydrobromic acid is 3·64442 grams per normal litre. This leads to the value 79·926 for the atomic weight of bromine.—J. **Eriksson**: The reappearance of mildew (*Phytophtora infestans*) in the potato.—M. **Repelin**: The age of the Oligocene deposits of the basins of Aix and Marseilles, and, in particular, of the clays of Milles and the lignites of Saint-Zacharie.—Mmes. M. **Lapicque** and C. **Veil**: Muscular velocities measured by chronaxy in the different cavities of the heart.—J. **Camus** and M. **Nepper**: The reaction times of the candidates for aviation. A criticism of a recent communication by M. Lahy. The authors find it difficult to explain the reaction times measured by M. Lahy, which appear to be much too small.—L. **Vialleton**: Ontogenic development and the analogous organs.—H. **Bierry**: The detection of tuberculous bacilli in sputa. Details of a method based on the liquefaction and subsequent centrifugation of the sputa, which has given good results in practice.

BOOKS RECEIVED.

Fossil Vertebrates in the American Museum of Natural History. Department of Vertebrate Palæontology. Vol. v., Articles collected from the American Museum Bulletin for the Years 1913–14. (New York.)

Scientific Method in Schools: A Suggestion. By W. H. S. Jones. Pp. 36. (Cambridge: At the University Press.) 1*s.* net.

Papers from the Geological Department, Glasgow University. Vol. ii., 1915. (Glasgow: J. Maclehose and Sons.)

The Genus Phoradendron: a Monographic Revision. By Prof. W. Trelease. Pp. 224+plates 245. (Urbana, Ill., U.S.A.: The University.)

Concentrating Ores by Flotation. By T. J. Hoover. Third edition. Pp. vi+320. (London: The *Mining Magazine*.)

The Nation of the Future. By L. Haden Guest. Pp. 115. (London: G. Bell and Sons, Ltd.) 2*s.* net.

An Emperor's Madness or National Aberration? By Prof. E. Lugaro. Translated by Dr. W. N. Robinson. Pp. v+135. (London: G. Routledge and Sons, Ltd.) 2*s.* 6*d.* net.

Department of Statistics, India. Agricultural Statistics of India, 1913–14. Vol. ii. Pp. v+116. (Calcutta: Superintendent Government Printing, India.) 1 rupee.

Preliminary Geometry. By F. Rosenberg. Pp. vi+220. (London: W. B. Clive.) 2*s.*

Commercial Arithmetic and Accounts. By A. R. Palmer and J. Stephenson. Part i., pp. xiv+292+lvi. Part ii., pp. xi+293–514+lvii–cliv. (London: G. Bell and Sons, Ltd.) Each 2*s.* 6*d.* net.

Return. British Museum. May, 1916. Pp. 110. (London: H.M.S.O.; Wyman and Sons, Ltd.) 5½*d.*

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THURSDAY, AUGUST 17, 1916.

NEUROLOGY.

An Introduction to Neurology. By Prof. C. Judson Herrick. Pp. 355. (Philadelphia and London: W. B. Saunders Co., 1916.) Price 7s. 6d. net.

ALL the special sciences naturally seek incorporation into some comprehensive scheme of thought which tends to embody the conceptions that we hold into one organic unity. Neurology, for instance, is brought out, with its component parts of anatomy, physiology, and psychology, into the conception of biology. In no department of human thought is this striving for an organic unity better exemplified than in the co-ordination and subordination of these special studies into the wider and more embracing science of biology.

The researches which have been brought together in this volume cover an immense reading; the references amount to many scores of contributions, and the book will be of great value to those who seek for an exact knowledge and a succinct account of the nervous system, the highest controlling machinery of animal and human life; for it is the nervous system that determines the adjustments and mutual relationships of all the other systems, as well as those of its own activities, which are so regulated as to promote its own welfare.

The study of neural actions must proceed from the more simple to the more complex—*i.e.*, from simple reflex action up to acts of consciousness involving deliberation, reflection, and judgment. This progress depends upon (*a*) a correlation, which is the resultant of all the afferent processes involved; (*b*) the co-ordination or orderly co-adjustment and sequence of these—absence of this means inco-ordination; and (*c*) the full association of responses secured by individual modifications. In the simple reflex mechanism there are three essential factors: (*a*) an initiating organ or receptor, sensitive to receive a stimulus which is often far less in intensity than the energy liberated, and which may only be some change of environment acting upon the organ; (*b*) a conductor to and from a correlating centre; and (*c*) an effector or organ of response—the data from these three instruments being as necessary for the most elementary nervous response as they are for the highest mental manifestations, including abstract thought. The author accepts the classic experiments of H. S. Jennings to explain the adaptation of an organism to its changing environment, and he divides behaviour or conduct (which he calls "action system") into two kinds, viz., that which is innate and invariable, and that which, through "docility or plasticity," is modifiable and variable or labile. He maintains that every reaction contains elements of both, the variable being characteristic of the higher animal type, implying an intelligently directed choice, yet expressed always through the agency of the lower centres.

The volume under review commences with a useful biological introduction, describing life as a correlation of physical forces for the conservation of the individual, the continued welfare of any living organism depending upon a properly balanced adjustment between itself and its surroundings—*i.e.*, between internal and external relations. An interesting chapter is devoted to the neurone or the nerve cell, which is itself an independent unit, leading an independent life, and separated from its fellows by a reticulated continuum—the synapse—yet it is linked with them by this fibrillar structure, which acts as a damper or a resistance to the passage of impulses, thus limiting excitability. The neurone effects the conduction of physico-chemical waves towards the effectors, but in one direction only, and this by means of its dendrites, axon, and collaterals, which are continuous with the nerve fibre. The author omits to mention the important discovery that the living neurone consists of protoplasmic granules, each surrounded with a lipoid oxidising substance; the Nissl granules of the neurone, or the tigroid bodies, being artefacts after death.

The last four chapters are devoted, fully but concisely, respectively to the physiological psychology of pain and pleasure—*i.e.*, the hedonic tone of consciousness connected with modifications of the subject by the object; the track of the pain nerves in the spinal cord being illustrated in the text; to the general anatomy of the cerebral cortex, and here, we note, there is no reference to the extremely valuable and important work of Dr. G. A. Watson on the mammalian cortex; and to reflex acts, instinct and intelligence. This chapter opens up two or more interesting psychological points, viz., whether reflex acts and instinct are only biological adaptations, and whether instincts are intelligent acts. In regard to these the opinions of psychologists differ, but the view of the majority is that every instinctive act is determined by intelligence. Between the chapters named the text is mainly histological and descriptive.

The book is concise and scientifically accurate, but owing to its extreme technicality it is difficult to read except by the expert anatomist or the senior advanced student. It certainly should be in the hands of every teacher of psychiatry. The illustrations are numerous and well chosen to illustrate the text, the bibliography is extensive, and the index as perfect as can be made and doubly useful through the help of the glossary. It may safely be added that the author has succeeded in his aim "to disentangle the inconceivably complex interrelations of the nerve fibres which serve all the manifold functions of adjustment of internal and external relations."

ROBERT ARMSTRONG-JONES.

PSYCHOLOGY.

(1) *Human Motives.* By Prof. J. J. Putnam. Pp. xvii+179. (London: W. Heinemann, 1915.) Price 5*s.* net.

(2) *Sleep and Sleeplessness.* By H. A. Bruce. Pp. ix+219. (London: W. Heinemann, 1915.) Price 5*s.* net.

(3) *The Meaning of Dreams.* By Dr. I. H. Coriat. Pp. xiv+194. (London: W. Heinemann, 1915.) Price 5*s.* net. (*Mind and Health Series.*)

(1) A READABLE volume, with many apt quotations for which Emersonians in particular will be thankful. Motives may be classified as, on the one hand, due to sense of obligations (virtually religious), and on the other to self-regarding, emotional impulses which are the outcome of biological evolution. Prof. Putnam emphasises and supports the rationality of religious ideals, remarking that, "in so far as religion is the expression of the truth, it expresses the most important aspect of the truth"—a pregnant phrase; and he advances weighty philosophical arguments in favour of Theism. On the biological side he follows Freud very largely in tracing many motives and ideas to repressed desires. He wisely realises that Freud goes rather far in pushing his theory, but argues that it is based on a large accumulation of data. A hostile critic might say with some justification that Freud came to conclusions and then interpreted all new data in terms of those conclusions; moreover—this is usually not sufficiently recognised—the data themselves are untrustworthy when accumulated by a theorist with an already elaborated system, for they will inevitably be influenced by his conscious or unconscious suggestion.

(2) We are still very ignorant of the physiology of sleep, but Mr. Bruce gives a good popular survey of the psychological side. Dealing with dreams, he explains the common flying dream as initiated by the rise and fall of the chest, plus absence of sensations from the soles of the feet; many dreams of discomfort in certain organs are due to incipient disease noted by the subconsciousness, though not known to the waking mind; and others are due to external stimuli as of noises outside or to memories. Briefly, it may be said that most dreams are attempts of the subconscious to interpret internal or external stimuli, the character of the dream being largely determined by the emotion-complexes which were roused by the experiences of the previous day. As to dreams in which problems are solved (*e.g.*, Prof. Hilprecht's case) or information apparently supernormally received (Miss Conley's case), Mr. Bruce quotes extensively from the Proceedings of the Society for Psychical Research, but thinks that all can be explained on normal lines. In attempting such explanation of some actual cases, however, the phrases "it is probable that," "it is safe to assume that," are notably frequent; and though we may sympathise with the author's aims, we may discern a certain rashness in his assumptions. On insomnia the anti-drug attitude is adopted, and stress laid on suggestion, for which, however, more is claimed than most practitioners would concede. A drug is sometimes necessary to break the insomnia habit; but either veronal, trional, or adalin is better than the old sulphonal, which is all that is here mentioned.

(3) More Freud. Every dream represents the fulfilment of a repressed wish. If during your father's lifetime you dream that he is dead, it is because, through jealousy of his place in your mother's affections, you wished him dead. If you deny it, the truth of it is confirmed; you did wish it, but the wish was repressed into the subconscious and forgotten. And if you do not dream that he is dead but only that he is an assistant in the business of which he is really the proprietor, the explanation is pretty much the same; you have evidently wished him superseded. Similarly with the flying dream: this is due to a wish for absolute freedom from all restraint. The dream-flyer is evidently a Free Lover and an Anarchist. If the dream absolutely refuses to be an Œdipus affair, you interpret by other wishes, remembering for your assistance that the dream itself is often a disguise. *E.g.*, a woman dreams that one of her brothers is going to be hanged. The interpretation is that in consequence of two other brothers having died of cancer and tuberculosis, which she therefore feared in her own case, she wished that they had died of something else; even hanging would have been preferable. Dr. Coriat advances this interpretation quite seriously. Now we may readily admit—without comparing Freud with Darwin, as Dr. Coriat does—that dream-observation and analysis are important for the investigation of the subconscious, and that Freud has done good pioneer work; but in both Freud and many of his followers the good work is vitiated by a peculiar narrowness. They suffer from *idée fixe*—a well-known psychosis. The neatness of the formula that every dream represents a repressed wish has hypnotised them, as a bright point will hypnotise the gazing subject, and they can see nothing else. We may hope before long for an interesting volume on the psychology of the Freudian psychologists analysing their peculiar obsession.

THE DECLINING BIRTH-RATE.

The Declining Birth-rate: Its Causes and Effects. Pp. xiv+450. (London: Chapman and Hall, Ltd., 1916.) Price 10*s.* 6*d.* net.

THIS book constitutes the Report of, and includes the chief evidence taken by, the National Birth-rate Commission, instituted, with official recognition, by the National Council of Public Morals. The committee was a strong one, and included upon it Dr. Stevenson, Superintendent of Statistics for the General Register Office, and Dr. Newsholme, Medical Officer of the Local Government Board. The subject of the declining birth-rate is one of enormous importance at the present time. The birth-rate reached a maximum

in 1876—36·3 per 1000 population—and has gradually fallen since then to about 23 at the present time, and this in spite of the marriage-rate having remained almost constant. The decline of the birth-rate has not operated uniformly throughout the country, but is more marked among the middle and upper classes. Thus in Hampstead the corrected birth-rate fell from 30·01 in 1881 to 17·55 in 1911, while the corresponding rates for Shoreditch are 31·32 and 30·16.

The general conclusion of the committee seems to be that the decline in the birth-rate is due to the deliberate limitation of families by anti-conceptives and other means. At the same time it is to be noted that the result of a census—a comparatively small one, it is true—taken by the Commission of those who employed anti-conceptive measures and of those who did not showed that the size of the families was slightly larger among the former! The conclusion arrived at by the Commission seems to be based upon the unanimous opinion of the witnesses of the extensive and increasing use of anti-conceptive measures, particularly among the more well-to-do classes of the community. Two of the witnesses, however, Dr. Chalmers and Dr. Brownlee, maintained that there are cycles in fertility, and that now we happen to be in a cycle of low fertility. Among the lower classes, especially in industrial areas, the use of abortifacients appears to be rife, and this may be a not unimportant factor in reducing the birth-rate.

Various topics bearing on the question are dealt with in the evidence, such as the influence of financial circumstances, housing, religious belief, etc. One point of interest brought out is that the fertility of "college" women seems to be as great as that of "non-college" women, though, as might be expected, the age at marriage of the former is somewhat higher than that of the latter.

The Commission is unable to formulate any measures for arresting the decline beyond the use of moral suasion to induce the married to fulfil their responsibilities.

The volume is an intensely interesting one, and should be in the hands of all who are interested in this national question. R. T. HEWLETT.

SANG'S SEVEN-PLACE LOGARITHMS.

A New Table of Seven-Place Logarithms of all numbers from 20,000 *to* 200,000. By Edward Sang. Reprinted from the original stereotype plates now in the custody of the Royal Society of Edinburgh. Pp. xviii + 365. (London: C. and E. Layton, 1915.) Price 21*s.* net.

THIS table was originally printed in 1870 from the stereotype plates in the custody of the Royal Society of Edinburgh. The present book is a reprint published in 1915.

Edward Sang (1805–90) was perhaps the greatest calculator of logarithms. An excellent account of the extraordinary energy that he brought to bear upon this work is to be found in a paper by Dr. C. G. Knott, of the Royal Society of Edinburgh, which forms part of the Napier memorial volume published in connection with the Napier tercentenary held in Edinburgh in July, 1914. Sang computed, independently of all previous work, the logarithms to twenty-eight places of all primes up to 10,037, each prime being put into relation to at least three others. By combination of these primes he tabulated the logarithms to twenty-eight places of all integral composite numbers from 1 to 20,000, a few gaps due to uncalculated primes being left. From this table he calculated by interpolation a great table of logarithms to fifteen places of all integral numbers from 100,000 to 370,000. Dr. Knott considers that Dr. Sang was justified in assuming the absolute accuracy of these tables to the fourteenth place.

This material, which may be regarded as a fundamental basis for all future tabulations, has never been published. All mathematicians would agree that publication should take place, and Dr. Knott discusses at length different methods of procedure. As the manuscripts are beautifully written he inclines to the opinion that it would be simple and a guarantee of accuracy to reproduce them as line engravings by photography. He considers that a quarto volume of some 1200 pages would suffice for the fundamentally important parts of the manuscripts, and he estimates that the cost of reproduction by photography would be about one-third or one-fourth the cost of setting them up in type in the usual way. It would, indeed, be a fitting outcome of the Napier tercentenary if this could be brought about, and the writer is convinced that if Dr. Knott and his colleagues in Scotland will persevere with the idea they will be astonished at the support they will receive even in these strenuous times.

This reprint is perfectly and conveniently printed with the usual description and examples of computation. P. A. M.

OUR BOOKSHELF.

Mentally Deficient Children: Their Treatment and Training. By Drs. G. E. Shuttleworth and W. A. Potts. Pp. xix + 284. Fourth Edition. (London: H. K. Lewis and Co., Ltd., 1916.) Price 7*s.* 6*d.* net.

WE welcome very heartily the fourth edition of Drs. Shuttleworth and Potts's excellent handbook on mentally deficient children. The book has been very carefully revised, and a chapter added concerning the mental troubles of youth. The main new feature of the present volume is an extremely interesting account of the Mental Deficiency Acts of 1914—these being the ultimate result of the Royal Commission of 1904.

The Acts now enable the authorities to deal with all mental defectives: (*a*) if under twenty-one years, at the instance of parent or guardian; or (*b*) at any age if found neglected, abandoned, destitute, or cruelly treated, criminal or inebriate, or being the pauper mother of an illegitimate child—and Dr. Shuttleworth states that "with the judicious administration of the new Acts it is hoped that Great Britain will stand ahead of

other countries in its treatment of the mentally defective class." He points out the great advantage of "the physiological education of the senses" (Séguin) of these children, and afterwards of their mental and moral education, both to the individual concerned and to the community. He shows how such children can find occupation and happiness as inmates of permanent working homes and contribute appreciably to the support of such homes, also how the "improved imbecile" is of far less risk to future generations, especially if carefully supervised.

Certain weak points in the Acts are dealt with, particularly the inadequate provision for "backward children," who tend to gravitate to the "special" schools, and the *inadequate after-care* of the children on leaving the institutions. This latter defect must necessarily damp the enthusiasm of the teachers, on whose devoted self-sacrifice the efficient working of the Acts is largely dependent. We strongly recommend the book to all interested in the subject, though mainly written for the medical profession. W. F. B.

The Microscopy of Vegetable Foods, with Special Reference to the Detection of Adulteration and the Diagnosis of Mixtures. By Drs. Andrew L. Winton, Josef Moeller, and Kate Barber Winton. Pp. xiv+701. Second edition. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 27*s*. 6*d*. net.

JUST as the sophistication of foods and drugs has developed, so have the means of detecting them been devised. For this purpose microscopical examination is one of the most important procedures, and a knowledge of the microscopic characters of the products and of their chief adulterants is therefore essential. Not only the analyst, but the miller, the brewer, the oil-presser, the cattle-food manufacturer, the canner, and the coffee and spice grinder, should all be conversant not only with the naked-eye characters, but also with the microscopic structure of their raw materials.

The present book, now in its second edition, deals with the needs of most of these industries, and the authors have, we think, successfully accomplished their task.

First, equipment, methods, and general principles are dealt with, after which the microscopic characters of the various products and their chief adulterants and impurities are described. In this way grain, oil-seeds, legumes, nuts, fruit and fruit products, vegetables, alkaloidal products and their substitutes (coffee, tea, cocoa, etc.), spices and condiments and commercial starches, are all considered at length, and an enormous amount of valuable information is collected and collated.

The text is illustrated with no fewer than 635 figures, and concludes with a full bibliography, glossary, and index. The book is, of course, especially written for American practice, and many articles are described which are rarely met with in this country, but it will be found none the less useful by our analysts and laboratories.

R. T. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Peculiar Thunderclap.

POSSIBLY some one of your readers may be able to throw light upon the peculiarity of a thunderclap which occurred here during a severe thunderstorm on July 27. This parish lies in a hollow of the hills, and almost always escapes close contact with thunderclouds. On the date mentioned a peal of extraordinary suddenness resembling the crashing burst of a big gun followed instantaneously a vivid flash at my point of observation. Two or three trees were afterwards observed to have been struck, and a paling rail near some wire was split into pieces and thrown some distance. Now the peculiarity is this: that very similar experiences were noted at places more than a mile distant and in various directions. The same crash following immediately on the lightning was noted by quite a number of independent witnesses. A mile to the east of this dwelling the lightning was seen to run down a wire fixed to the top of a flagstaff. About a mile to the north a farmer driving home was alarmed to see the lightning flash along the wire paling by the roadside and split one post at least and cast the fragments on the road.

On considering all the circumstances, I think the following may be an explanation. The thunderclouds which contributed mostly to the storm were floating at a pretty high elevation, possibly 2000 ft., as during the greater part of the day they were just grazing the tops of the hills. But about 3 p.m. a bank of cloud began to form in this hollow much nearer the ground, and half an hour later, when the thunderclap came, the light was much obscured. My opinion is that the lower cloud drew an overwhelming charge from the clouds above, and accordingly flashes sped to earth from several points at the same instant.

I have, of course, made certain that we are dealing here with one and the same thunderclap, as was not difficult to do, seeing that all the other peals of thunder were comparatively distant. JOHN DON.

Lumphanan, Aberdeen, July 30.

The Gun-firing on the Western Front.

THE firing of very heavy guns at a great distance was clearly audible at Harpenden throughout the days of August 7 and 8, as well as on previous occasions. The direction of the sound is evidently from the south-east, and that of each explosion lasts about two seconds. Our elevation is 440 ft., and the local wind has been from west to north-west. The distance between Harpenden and Bapaume would be about 185 miles. SPENCER PICKERING.

MR. PIPER's letter (NATURE, August 3) is interesting. My extended experience confirms his. When the great bombardment began I was staying at a farmhouse on high ground near Chilham, Kent. We heard the firing day and night during the two weeks, and I roughly calculated that three or four guns were fired *per second*. During almost all the time the wind was S.W., and often quite strong, yet this did not interfere with the sound if one was sheltered from the wind and away from rustling foliage.

The firing front would be S.E., and about 100 miles away. I. W. BOOTHROYD.

9 The Circus, Greenwich, S.E.

THE PRESIDENCY OF THE BOARD OF EDUCATION.

THE office of President of the Board of Education has again become the shuttlecock of politics, pointedly illustrated by the remark so aptly made by a member of the House in the course of the important debate of July 18 on the introduction by Mr. Henderson of the Education Estimates, that "I have sat for eleven years in this House, and I have heard during that time no fewer than five Ministers make their statements on educational matters." It is thus that we are content to deal with the vital question of education. The circumstances of the war have forced home upon the attention of the least reflective of politicians the claims of the subject to the serious attention of the nation.

The course of the debate, in which members of very diverse political views participated, indicates that the time is fully ripe for a drastic review of the question in all its bearings. To do this effectively requires that there should be placed in control of the department, which should now take an equal place in the hierarchy of Government with the other great departments of the State alike in respect of the salary attached to it and of the dignity and responsibility in which it is held, a man of large and clear vision, of intimate knowledge, and of deep sympathy with the educational well-being of all classes of the people, and who is prepared with a single mind to devote all his time and thought to the consideration and solution of the serious problems which beset it. We have got as the most pressing need of the time to create in the English nation, as distinguished, say, from the Scotch, a genuine belief in the value of education as the true and only uplifting and sustaining force in the spiritual life and continued progress of the people. This can only have some chance of realisation in the event of the office of Secretary of State for Education—since that should be its rightful designation—being in the hands of such a man as is here described, who enjoys the confidence of the people and is prepared to regard the office, not as a stepping-stone or mere adjunct to some other, but as one demanding a continuity of thought and policy throughout the whole time his Government is in power. Such a Minister should be prepared, not merely from his place in Parliament, but from time to time in various great centres of population, to set forth his policy and to seek to arouse in the people by the enunciation of his ideals and by the methods of their realisation a great enthusiasm for education as the true foundation of the national salvation. It is not a question of a classical education *versus* an education in science, nor a question of industrial and commercial supremacy, nor of one *class* as distinguished from another, but of the right upbringing and development of all the children of the nation according to their gifts and capabilities. To a man of such distinction as is here foreshadowed would inevitably be committed a full inquiry under his presidency and with the aid not merely of officials, but also with that of the best available thought and ripe experience of every class, into the present conditions of education as exhibited throughout its entire range, from the kindergarten up to and including the university, with a view to its unification and to the establishment of a broad highway along which the gifted children of the nation might freely travel. This, as the course of the recent debate shows, is the psychological moment, and it should be seized with a firm hand. It will mean, as Mr. Henderson puts it, "money and more money." It will demand a higher and more attractive status for the teacher, with a clear avenue for the highest public service of which he is capable. But it will result that the coming generation of Englishmen will possibly be as receptive and as appreciative of the fruits of investigation, often enough due to the patience and genius of their own countrymen, as are the foreign enemies whose culture they hold in such disdain.

EXPERIMENTS IN AERODYNAMICS.[1]

THE volume before us gives some of the first results obtained in the four-foot wind tunnel which has been erected at the Massachusetts Institute of Technology, and consists of ten sections dealing with various phases of the work. The first section gives a detailed description of the wind tunnel, the design of which is practically identical with that of the four-foot tunnel at the National Physical Laboratory, Teddington. This is followed by a discussion of the dimensional theory as applied to aerodynamic problems. The theory is treated in a simple and easily followed manner, but due credit has not been given to Lord Rayleigh, who first proposed the theory in this form. Lord Rayleigh is mentioned, however, in this connection in a later section of the book. Section 3 deals with the inclined tube alcohol manometer for measuring small pressure differences. The results of the calibration of such an instrument against a standard Chattock manometer are given. The inclined tube instrument certainly has no advantages over the Chattock form, and experience at the National Physical Laboratory shows that the latter is exceedingly convenient for use. The theory of the pitot tube is considered, and experimental results are appended to show that several types of combined pitot and static pressure tubes give identical calibrations.

An interesting comparison with the National Physical Laboratory is given in the form of characteristic curves for the wing section known as R.A.F.6, and this comparison shows in a striking manner the accuracy of wind tunnel experiments. The results obtained in the two wind tunnels agree to the order of about 2 per cent., which is as good as the accuracy of manufacture of the models will allow.

The question of the steering of a dirigible is dealt with in one section of the volume, and the conclusion is drawn that it is almost out of the

[1] "Report on Wind Tunnel Experiments in Aerodynamics." Smithsonian Miscellaneous Collections, vol. lxii., No. 4.

question to put sufficient fin area on a dirigible to render it directionally stable, but that it may be controlled by comparatively small movements of the rudder. This conclusion is also in agreement with National Physical Laboratory results.

Section 8, on swept-back wings, and the following section on the effects of dihedral angle, are of considerable interest. The Dunne aeroplane has excited much interest, and great claims have been made for its stability. The results of the experiments in the American wind tunnel show that the effect of swept-back wings on longitudinal stability is nil, and that the degree of lateral stability due to a sweep back of 20° is equally well obtained by a dihedral angle of only $2\frac{1}{2}°$, while the latter is much better from a constructional point of view.

The last section deals with the critical flow round flat discs normal to the wind. A mathematical investigation is given for the case of non-viscous irrotational motion, and it is shown that the results are of the same order as those of the experiments. The mathematical treatment is obviously inadequate, since it ignores just those qualities of the motion which affect its critical change of flow: the viscosity and the rotational motion. Similar problems have received attention at the National Physical Laboratory, and it is hoped to obtain, from actual photographs of the motion in special cases, some information which is not forthcoming from the hydrodynamical theory.

On the whole, the results given in the Smithsonian publication are very interesting and afford a useful independent comparison with those obtained in our own country at the National Physical Laboratory. The excellent agreement obtained in the general conclusions of the present volume with the previous work at the National Physical Laboratory leaves no possible doubt concerning the accuracy of experimental work of this description, or of the great utility of such experiments in helping forward the design of all kinds of aircraft.

E. F. R.

GEOFFREY WATKINS SMITH.

BY the death of Captain Geoffrey Watkins Smith, of the Rifle Brigade, who was killed by a shell in France on July 10 in a trench just taken from the enemy, zoological science loses one of the most promising and brilliant of its younger adherents, and his many friends have to regret a particularly lovable and gracious personality. Though only thirty-four years of age, Geoffrey Smith, by the abundance and originality of his researches, had won for himself a secure place in the scientific world, and his work was of such a nature that each step gave promise of further and more important discovery. It is not possible within the present limits of space to give more than a bare outline of his career and performance.

Geoffrey Smith, a son of Mr. Horace Smith, the well-known Metropolitan magistrate, was born at Beckenham, Kent, on December 9, 1881. He was educated at Temple Grove, East Sheen, and afterwards at Winchester College, of which he was a scholar, and in due course obtained a scholarship at New College, Oxford. At Oxford, working under the late Prof. Weldon, he devoted himself to the studies for which he had already shown great aptitude in boyhood, and gained a first class in the Honour School of Natural Science in 1903. He proceeded to the Zoological Station at Naples in the same year, and remained there till 1905, when, having finished his monograph on the Rhizocephala, the only monograph in the Naples Fauna and Flora written by an Englishman, he returned to Oxford to take up the duties of demonstrator and lecturer in the University Museum. In 1906 he was elected fellow and tutor of New College in succession to Prof. G. C. Bourne, and remained at Oxford till October, 1914, except for an excursion to Tasmania in 1907, the scientific results of which are published in a volume entitled "A Naturalist in Tasmania."

Geoffrey Smith's monograph on the Rhizocephala, an excellent piece of zoological research, has already been mentioned. As a result of his voyage to Tasmania he made several solid contributions to zoological science, publishing a memoir on the Anaspidacea, living and fossil, in 1909, and monographs on the fresh-water Crustacea of Tasmania and on the fresh-water Crayfishes of Australia in 1909 and 1912. But his chief and most important work was his series of memoirs, eleven in number, on the experimental analysis of sex, issued from 1910 to 1914. In these essays, following up clues suggested to him by his work on the Rhizocephala, Geoffrey Smith attempted, and attempted successfully, to probe the physiological causes of the phenomena of secondary sexual characters. He showed that the assumption of female characters by the parasitised male crab Inachus is due to a profound change in metabolism induced by the parasitic Sacculina, and incidentally demonstrated that the facts proved that the male is heterozygous and the female homozygous for sex. By a masterly association of ideas he showed the close analogy between this physiological regulation in parasitised crabs and the phenomena of regulation which produce immunity in bacterial diseases. He extended his observations to bees, frogs, fowls, and pheasants, and successfully demonstrated similar physiological processes in these animals, at the same time bringing acute critical experimental work to bear on certain current theories of sex production.

Much had been achieved, but much was left unfinished when he accepted a commission in the New Armies in 1914. It is doubtful whether the work so brilliantly initiated can be carried on by any other hand, certainly not with the same prospect of success.

A final word must be said in praise of the elegance of Geoffrey Smith's literary style, and the grace, humour, and courtesy with which he was wont to deal with attacks upon his work.

NOTES.

ON the initiative of the Royal Society, a Board of Scientific Societies, consisting at present of representatives of twenty-seven scientific, including technical, societies, has been established for the furtherance of the following objects:—Promoting the co-operation of those interested in pure or applied science; supplying a means by which the scientific opinion of the country may, on matters relating to science, industry, and education, find effective expression; taking such action as may be necessary to promote the application of science to our industries and to the service of the nation; and discussing scientific questions in which international co-operation seems advisable. An executive committee has been appointed, consisting of the following members:—Sir Joseph Thomson (chairman), Dr. Dugald Clerk, Sir Robert Hadfield, Mr. A. D. Hall, Prof. Herbert Jackson (hon. secretary), Sir Alfred Keogh, Sir Ray Lankester, Prof. A. Schuster, Sir John Snell, Prof. E. H. Starling, Lord Sydenham, and Mr. R. Threlfall. The first meeting of the Board was held on July 20, when important questions relating to scientific, educational, and industrial matters were under consideration, with a view to effective steps being taken for co-ordinating the work carried out at present by a number of independent bodies, or initiating action in the case of other matters of national importance.

IT is announced that the *Discovery*, with the Shackleton Relief Expedition, left Plymouth Sound last Thursday. She will proceed to Port Stanley, Falkland Islands, to embark Sir Ernest Shackleton, and then leave for Elephant Island. It is hoped that she will reach the Falkland Islands by the end of September, and Elephant Island a week later. The *Discovery* should have no difficulty in penetrating the pack and reaching the stranded men. On the other hand, it is quite possible that the conditions will be so favourable in October that little or no ice will be encountered. Lieut.-Commander J. Fairweather, R.N.V.R., is in command of the *Discovery*. He has had long experience among Arctic ice, although this is his first visit to the Antarctic.

IT is stated in the *Times* that the sum of 2500*l*. is being raised by the Archangel Society for the study of the Russian Far North, in furtherance of the search for the two Russian expeditions which sailed in 1912 under, respectively, Lieut. Brusiloff and M. Rousanoff. The money in question is to be used as rewards for information obtained as to the fate of the explorers.

A COLLECTION of British-made laboratory apparatus is on view at the Institute of Chemistry, 30 Russell Square, W.C. The exhibition will remain open until the end of September.

A WARNING against the suggested use of benzoate of soda as a substitute for sugar in jam-making has been issued by the Board of Agriculture and Fisheries. It is pointed out that serious results may follow if the substance in question is used for the purpose named.

THE programme of the celebrations on June 13 in connection with the centenary of the Botanic Gardens, Sydney, has just reached us. Speeches were delivered on the occasion by the Governor of New South Wales, the Premier, and the Minister for Agriculture, and a brief historical address was given by Mr. J. H. Maiden, F.R.S., the director of the gardens. Three vistas were named respectively after Capt. Cook, Sir Joseph Banks, and Governor Phillip, and a rosery is to be known in future as the "Centenary Rosery." The following memorial trees were planted simultaneously by representatives of the Empire and the Allies:—Great Britain and Ireland, the British Oak (*Quercus pedunculata*); Australia, the Bunya Bunya (*Araucaria Bidwilli*) and the Flame Tree (*Brachychiton acerifolia*); Sydney, the Port Jackson Fig (*Ficus rubiginosa*); New Zealand, the Kauri (*Agathis australis*); South Africa, the Cape Chestnut (*Calodendron capensis*); Canada, the Sweet Gum (*Liquidambar styraciflua*); India, Indian Date Palm (*Phoenix sylvestris*); Belgium, Black Belgian Poplar (*Populus monilifera*); France, Nettle Tree, or Perpignan Wood (*Celtis australis*); Russia, the Aspen (*Populus tremula*); Italy, Lombardy Poplar (*Populus nigra*, var. *pyramidalis*); Serbia, the Carob (*Ceratonia siliqua*); Montenegro, the Olive (*Olea europaea*); Portugal, Portugal Laurel (*Prunus lusitanicus*); Japan, Japanese Maple (*Acer japonica*); after which a memorial stone of a proposed museum of botany and horticulture was laid.

WE regret to record the death of Mr. Charles Dawson, which occurred, after a long illness, at Lewes on August 10. Mr. Dawson was born in Lancashire on July 11, 1864, but spent most of his early life at St. Leonards-on-Sea, where he soon became interested in the geology and archæology of the neighbourhood. Encouraged by the late Mr. S. H. Beckles, he devoted attention especially to the fossil remains of reptiles found in the Wealden formations quarried round Hastings, and made a large collection, which he placed in the British Museum, and continually enriched almost until the end of his life. He discovered some new species of iguanodon, of which one was named after himself by Mr. R. Lydekker. After persistent search in the bone-beds for many years, Mr. Dawson also found the first tooth of a Wealden mammal (*Plagiaulax dawsoni*). His interest in archæology gradually led him to studies of prehistoric man, and for many years he searched the gravels and other superficial deposits of southern Sussex for traces of man and his handiwork. He was ultimately rewarded, in 1912, by the discovery of the now famous skull and mandible of *Eoanthropus dawsoni* in a very old gravel at Piltdown, near Uckfield. During his busy professional career as a solicitor Mr. Dawson never neglected any opportunity of contributing to the knowledge of the geology and archæology of the district in which he resided, and his comparatively early death is a distinct loss to science.

THE death is announced, in his seventy-third year, of Dr. William Simon, professor of chemistry at the Baltimore College of Physicians and Surgeons since 1880. He was president of the Maryland Pharmaceutical Association in 1887. Dr. Simon was the author of a manual of chemistry, and had done special work in autochromatic photography.

THE death is announced, at the age of seventy-four years, of Dr. Ferdinand Fischer, professor of chemical technology in the University of Göttingen.

THE report of the Advisory Committee for Aeronautics, 1915–16, contains a summary of the work carried out by the Advisory Committee during the past year, and shows in a striking way the effect that the war has had upon aeronautics in general and upon experimental aeronautics in particular. The experimental work at the National Physical Laboratory is first dealt with, and the extent of the developments in this branch of the work is very marked, the aeronautical department at the laboratory having prac-

tically doubled in size since the outbreak of war. The experimental work that has been done covers a wide range, including experiments in the wind channels on models of aeroplanes and parts of aeroplanes, airships, and kite balloons; investigations into the strength of fabrics, wing spars, light alloys, stream-line wires, and other materials of construction; and researches into many special subjects that have arisen from time to time. The work of the Royal Aircraft Factory is summarised, with particular attention to the experimental side of the work, and to the endeavours which are being made to link up model experiments with full-scale tests. Considerable stress is laid on the precision with which the performance and stability of a new design can now be calculated, and on the fact that it has been found possible to obtain large quantities of good, stable, and serviceable machines from firms without previous experience of aircraft construction by providing them with complete drawings and details. The design of new machines proceeds by making a few trial machines, and four main types have been standardised for contract purposes. A brief account of the work done specially for the Admiralty Air Department, and of the meteorological work of the past year, completes the report. The technical appendix, containing detailed results of experiments, cannot, of course, be published during the war, but it is clearly emphasised in the report itself that the detailed technical results are freely communicated to Government contractors who need them, and who apply for them through the proper channels.

THE paper by Messrs. H. J. Fleure and T. C. James, published in the Journal of the Royal Anthropological Institute, vol xlvi., January–June, 1916, one of the most valuable recent contributions to the study of the races of Great Britain, must be read as a whole with due regard to the mass of statistics on which the authors base their conclusions regarding the geographical distribution of anthropological types in Wales. At present they are inclined to believe that a Brythonic advance into Wales, probably *viâ* Powys, occurred at some time not remote from the Roman invasion. It may have been in waves pushing back old languages or dialects which were probably nearer to the Gaelic group than is Brythonic. As regards physical types, they note a characteristic increase of the fair, medium-headed type as we descend into the Severn basin and that of the Wye, and all through this region, and the Welsh border generally, there is a suggestion of dilution of pigment in the Neolithic or Mediterranean type. Whether this can be connected with the Brythonic invaders is doubtful; it may be due to later infiltration. They also remark that while the fair-haired, light-eyed men of the Severn and Wye valleys often have medium to broad heads, this type also appears in eastern England. The suggestion is made that in the latter area the infusion may be partly Brythonic, partly Anglo-Saxon. It is not safe to assume that the fair men in eastern England are necessarily post-Roman Teutons; they may be Brythons, and it is difficult to distinguish their ultimate origin. There is at least the possibility that the pre-Roman peoples are fairly well represented even in East England.

IN the Journal of the Royal Anthropological Institute, vol. xlvi., January–June, 1916, Mr. Harold Peake investigates the ethnology of the people who destroyed the Trojan city known as Hissarlik II. Following the lead of Mr. Ellsworth Huntington, he suggests that a period of drought, beginning about 2450 B.C., led to extensive race movements of Arabian tribes across the Sinaitic peninsula into the Egyptian delta, while later waves successively invaded Palestine and Syria, introducing the knowledge of metals, perhaps gained from their kinsmen in Egypt, and founding Damascus. Thence they migrated to Assyria and Babylonia. Meanwhile the drought in the steppes adjoining the Caspian led to the migration of the Bak tribes into China. Later on the Nordic steppe-folk on either side of the Volga, finding their pasturage diminishing, occupied the region abandoned by the Bak tribes, and passed into Persia, where they became known as the Kassites. Others of the same group overran Galicia and Rumania, and penetrated into Hungary and Thrace. This last body divided into two groups; one occupied the Larissan plain, while another party crossed the Hellespont, destroyed Hissarlik II., and poured into Anatolia. These may have later appeared south as the Amorites, or they may survive to the present day as the Kurds. Many of these conclusions are speculative, but the theory now presented with a considerable array of corroborative evidence clears up many difficulties, and is decidedly attractive.

THE Royal Botanic Gardens, Kew, have received a very interesting and valuable presentation from Lady Church in the collection of botanical water-colour drawings brought together by the late Sir Arthur Church. The drawings have been placed in a room leading out of the North Gallery—once Miss North's studio—and are now open to public inspection. The exhibition of the pictures has been made possible by the generosity of Lady Church. There are some fine examples of the work of Simon Varelst, G. D. Ehret, R. P. Nodder, A. Power, and other well-known flower painters. In order to make the collection as representative as possible some examples of the work of W. H. Fitch, Sir J. D. Hooker, F. Bauer, and others have been placed on the walls from the collection of paintings already at Kew. An account of the collection is given in Kew Bulletin, No. 6, 1916.

THE luminous and very poisonous fungus, *Pleurotus japonicus,* which grows on decaying trunks of the beech tree in Japan, has been investigated by Katamura in the Journal of the College of Science, Tokyo, vol. xxxv., p. 1. The light is emitted from the gills, which are luminous all over, and the range of temperature for luminosity is 3°–40° C. It is stated that 100 sq. cm. of luminous area gives light enough for reading, and that the light is noticeable for a distance of some 30 m. The poisonous properties of the fungus do not appear to be destroyed by cooking.

THE wild and cultivated forms of the Japanese cherries form the subject of a monograph by M. Miyoshi in the Journal of the College of Science, Tokyo, vol. xxxiv., art. 1. The species concerned are *Prunus mutabilis,* Miyos., *P. sachaliensis,* Miyos., and *P. serrulata,* Lindl. Some sixty-eight varieties of the last-named species are described and figured in a series of very beautiful coloured plates. Ten forms of *P. sachaliensis* and sixty-five forms of *P. mutabilis* are similarly described and illustrated. There is some introductory historical matter, and under each form the Japanese name, flowering time, and other particulars are given. Many of the forms are now known in Great Britain, but the monograph deserves careful study by all lovers of flowering trees, if only because of the artistic beauty of the plates.

THE *Scottish Naturalist,* in the form of a double number (July–August), is devoted entirely to the "Report on Scottish Ornithology in 1915." Though this *résumé* contains nothing of very remarkable import, it is full of interesting items. Among these must be mentioned an extension of the breeding range of

the gannet, four pairs of which nested on the Noup of Noss, Bressay, Shetland, during this season. Until now all the known nesting-places of this species in our islands, with the exception of the Bass Rock, have been on the west coast. This report is the work of Misses Evelyn Baxter and Leonora Rintoul, and we regret to notice that while showing a determination to be very up-to-date in the matter of nomenclature they have not adopted that laid down by the British Ornithologists' Union, of which they are honorary members.

In the *Irish Naturalist* for July Mr. R. A. Phillips describes and figures two species of fossil Pisidium new to Ireland. They were obtained from a deposit in the Suir, near Fiddown, about fifteen miles above Waterford. One of these, *P. supinum*, was found in association with a thickened, triangular form of *P. casertanum*, which it closely resembled; the other, *P. parvulum*, has apparently not previously been recognised as a British species, having been "confused with, and mistaken for," the young of *P. supinum*. Mr. Phillips, in his paper, gives the distinguishing characters between the two species in tabular form. Many of the shells which he has obtained from the Suir and Shannon have all the appearance of drift-shells only recently killed; hence it is probable that the species will be found living in both rivers. For similar reasons he believes that *P. supinum* will also be found living in Irish rivers.

The second volume of "Papers from the Geological Department, Glasgow University" (see Nature, vol. xcvi., p. 236), bears further testimony to the energy of Prof. J. W. Gregory and his colleagues. One of the most notable contributions is that in which Prof. Gregory records the discovery of pebbles of the Moine Gneiss in Torridon Sandstone, and thus makes a marked advance in the stratigraphy of the Scottish Highlands. His description of "Pseudo-Glacial Features in Dalmatia" contains several illustrations from the karstland that are specially interesting at the present time.

Dr. H. H. Hayden's "Notes on the Geology of Chitral, Gilgit, and the Pamirs" (Rec. Geol. Surv. India, vol. xlv., pub. 1916, p. 271) need no apology for incompleteness. They were drawn up during steady journeying in a region of rocky and snow-capped heights, of which the photographic illustrations give a striking record. Dr. Hayden finds that the trend-lines of the mountains between the Pamirs and Kungur and Mustagh-ata do not present anomalies such as Suess and Fütterer pointed out. Stoliczka's and Ivanov's observations on the Pamirs, published in 1878 and 1886, are now for the first time supplemented.

Dr. W. F. Smeeth's "Outline of the Geological History of Mysore" (Bangalore, price one rupee) is accompanied by a coloured geological map of southern India, on a scale of about one inch to one hundred miles. The references to the banded iron-ores, the quartz-magnetite dykes or tongues in charnockite, and the intrusive character of the "peninsular gneiss," once regarded as "fundamental," are brief, but are suggestive for comparison with other pre-Cambrian regions. The Dharwar schists have affinities with the Keewatin series of North America.

The remarkable new canal between Arles, on the Rhone, and Marseilles is the subject of an article by Prof. Piero Gribaudi in the *Bollettino della Reale Societa Geographica Italiana* for July (vol. v., No. 7). The canal, which was opened last May, is carried through the hills north of Marseilles in a tunnel four and a half miles long and 72 ft. wide, with a depth of 10 ft. of water. It will make direct barge traffic possible between Marseilles and the Rhone. Equally important is the construction of a new line of railway from Marseilles to Miramas, where it connects with the Paris-Mediterranean line. This new line leaves Marseilles westward along the coast, and is an alternative to the long Nerte tunnel, which was always the weak link on the old line in case of an accident.

The Canadian Department of Mines has just published a volume (Bulletin No. 11) upon the "Investigation of the Peat Bogs and Peat Industry of Canada in 1913–14," by Aleph Anrep, which will be found interesting to all concerned in the problem of the utilisation of peat. It may be looked upon as a continuation of the volumes upon peat already issued by the same Department, and brings the information upon this subject well up to date. The first portion contains detailed descriptions of a number of peat bogs in Ontario, Quebec, Prince Edward Island and Nova Scotia, and is followed by a particularly well illustrated account of the botany of these bogs. This is followed by a series of notes upon special appliances for the manufacture of peat fuel, and upon the peat production in certain foreign countries, and an appendix contains abstracts of Canadian patents for excavating and handling peat and for the manufacture of peat fuel. This bulletin is a further example of the sedulous care with which the Canadian Government endeavours to foster the development and utilisation of the natural resources of the Dominion; it is greatly to be desired that the example thus set may be followed in our country, and that we may see before long some Government department specially charged with the duty of seeing that British natural resources are turned to the best possible account.

An attempt to gauge the agricultural possibilities of Australia so far as the climatic factor is concerned has been made by Mr. Griffith Taylor, and his results are published in Bulletin No. 11 of the Commonwealth Bureau of Meteorology. The scope of the inquiry includes the distribution of cattle, sheep, and wheat. Rainfall is the chief control in the case of wheat, and scarcely of less value as regards cattle and sheep. Temperature is an important factor in the case of wheat, and of considerable influence in the distribution of sheep. Cattle, on the other hand, show a wide adaptability to temperature. The author briefly considers the topographic control and the question of accessibility, but to both these, as well as to the question of soil, more attention would need to be paid to make such a survey complete. These, however, he rules outside the scope of the memoir. From a consideration of the temperature and rainfall in the wheat lands of Texas and northern India, Mr. Taylor concludes that south-eastern Queensland is well suited for wheat grown under the same conditions. The area at present under wheat in Queensland is small. In these new wheat lands it is suggested that the Indian practice should be followed of planting the wheat towards the end of the summer rains—that is, early in March. The wheat would ripen in about four months, during which it would receive an additional five inches of rainfall.

It is, we think, almost an article of faith amongst chemists that the preparation of sodium chloride pure enough for ordinary analytical operations is a comparatively easy matter. But, according to Mr. Clifford Lohman, who writes from Cornell College in the *Chemical News* of August 4, this is not the case. Three specimens of sodium chloride (presumably of

American manufacture), each alleged to be chemically pure, contained respectively 0·57, 0·45, and 0·49 per cent. of potassium chloride. Samples prepared by this author (1) by precipitation of a saturated solution of common salt with hydrogen chloride; (2) by purification with milk of lime, excess of which was precipitated with sodium carbonate, the excess of the latter being neutralised with hydrochloric acid; (3) from metallic sodium by dissolution in water and neutralisation of the solution with hydrochloric acid; and (4) by neutralising with hydrochloric acid a solution of the most nearly pure caustic soda (not purified with alcohol), contained respectively: (1) 0·42, (2) 0·32, (3) 0·27, and (4) 0·48 per cent. of potassium chloride. In each case the potassium was estimated by the platinic chloride method. It would be interesting to learn whether the "chemically pure" sodium chloride of English origin is equally contaminated.

The ions of low mobility the presence of which in air at ordinary pressures was discovered by Langevin have frequently been called large ions owing to the belief that their low mobility was due to their relatively great mass. Some measurements made at the suggestion of Prof. Millikan by Mr. L. B. Loeb, and published in the July Proceedings of the American Academy of Sciences, seem to indicate that this belief was unjustified. Using the alternating-field method of Rutherford, Mr. Loeb has measured the mobilities of both positive and negative ions at fields from 90 to 12,000 volts per centimetre, and in neither case has he found any marked increase in the mobility. At the high speeds due to the strong fields the clusters of uncharged molecules about an electron, which were supposed to constitute the ion of low mobility, should be broken up and the mobility show an increase corresponding to the reduced mass. As the measurements show no such increase, the author adopts the theory that each ion consists of a single molecule and its low mobility is due to the action of its charge on neutral molecules increasing the number of collisions.

According to the *Scientific American*, there has been a remarkable increase, since the war commenced, in the number of American engineering firms who make use of the metric system of measurement. Many firms who two years ago upheld the yard, foot, inch, eighths, sixteenths, thirty-secondths, and sixty-fourths as more convenient than the metre and its decimal subdivisions are now turning out machines gauged solely on the metric system. This remarkable *volte-face* appears due to the desire on the part of American firms to meet the demand for machinery which, in the past, has been supplied by Germany. Whatever the reason for this rapid change, the fact that it has been carried out voluntarily in so short a time seems a sufficient refutation of the argument that the introduction of the metric system into engineering works in this country would cause endless confusion and great expense.

We have received from Prof. R. Gautier, director of the Geneva Observatory, the annual report describing the chronometrical service carried on in that institution. It appears from the report that the war has affected the activity of the observatory very adversely, and that the number of instruments submitted to trial conditions has fallen below that of any year since 1872. Of marine chronometers only one has been received, and of pocket watches, 152, as against 296 in 1914. M. Gautier takes, however, a hopeful view of the national industry in the future when normal conditions have returned, basing this opinion on the improved character of the work. For if the number of instruments has been less, the proportion of those which obtain the highest certificate of excellence has increased. No less than 95 per cent. of the whole deposits has obtained a first-class certificate, and less than 10 per cent. of the instruments submitted to test has failed. These figures constitute a record in the history of the annual trials. M. Gautier gives some details of the examination of chronometers at the neighbouring observatories of Neuchatel and Besançon, giving also an abstract of the Kew results for comparison. The effect of the war is everywhere noticeable in the quantity of instruments deposited, but the quality of the work is everywhere maintained with gratifying uniformity. The general adoption of the Guillaume balance has contributed to this successful result. In the Kew report it is stated that the Swiss manufacturers have universally adopted the Guillaume type, and "il n'y a pas de doute que l'emploi de ce type de balancier contribue largement aux brillants résultats obtenus par les montres déposées par ces fabricants."

In response to many requests, the Board of Agriculture and Fisheries has issued (at 1*s.*) a second edition of vol. i. of the "Special Reports on the Mineral Resources of Great Britain." It will be remembered that the work deals with the uses, distribution, treatment, and output of tungsten and manganese ores, and that in it particulars are given of the mines containing the ores.

An interesting volume has been sent to us by the Royal Cornwall Polytechnic Society, entitled "Historical Synopsis of the Royal Cornwall Polytechnic Society for 81 Years, 1833–1913," by Wilson Lloyd Fox, with indexes by Howard Fox. The work is divided into two parts, covering the periods 1833–81 and 1882–1913. The activities of the society have been numerous and valuable, and merit this permanent record.

A new series entitled the "Cambridge Botanical Handbooks" is being edited by Prof. A. C. Seward and Mr. A. G. Tansley for the Cambridge University Press. The development of certain branches of botanical science in recent years has emphasised the need for books by specialists on different groups of the vegetable kingdom, and the new series is being issued to meet this want. A book by Prof. West dealing biologically with all the algæ included in the Myxophyceæ, Peridinieæ, Bacillacieæ, and Chlorophyceæ, both fresh-water and marine, will be the first volume to appear. It will be followed by another work by Prof. West, on all the fresh-water algæ (with the exception of desmids and diatoms) which are known to occur in the British Isles. Volumes on lichens, fungi, and gnetales, by Miss Lorrain Smith, Dr. Helen Gwynne-Vaughan, and Prof. Pearson respectively, are in an advanced state of preparation.

The Harvard University Press (Cambridge, Mass., U.S.A.) has begun the publication of a series entitled "Harvard Health Talks," being the substance of some of the public lectures delivered at the Medical School of Harvard University, and aiming at providing in easily accessible form modern and authoritative information on medical subjects of general importance. Among the volumes in the series we notice "The Care and Feeding of Children," by J. L. Morse; "Preservatives and other Chemicals in Food: their Use and Abuse," by O. Folin; "The Care of the Skin," by C. J. White; "The Care of the Sick Room," by E. G. Cutler; and "The Care of the Teeth," by C. A. Brackett. The series is published in this country by the Oxford University Press.

OUR ASTRONOMICAL COLUMN.

A Large Solar Prominence.—An eruptive prominence of exceptional altitude was photographed by Mr. Evershed at Srinagar, Kashmir, on May 26, 1916. Photographs were obtained at intervals from near the beginning of the outburst until the final fragments had risen to a height of a little more than a semi-diameter from the sun's limb. The velocity away from the sun was 190 km. per sec., and faint extensions could be traced at 18′ from the limb, representing a height of close upon half a million miles. This would appear to be the highest prominence which has yet been recorded. (*The Observatory*, vol. xxxix., p. 358.)

The Spectroscopic Binary σ Aquilæ.—The variable radial velocity of this star, detected at Mt. Wilson in 1912, has been further investigated by Mr. F. C. Jordan (Pub. Allegheny Obs., vol. iii., No. 22). The star is interesting as one in which both components are readily observed separately. Both spectra are of type B 8, and from their relative intensities it is inferred that the components differ in brightness by about half a magnitude. The period is 1·95022 days, with a probable error of about $8\frac{1}{2}$ seconds. The orbit is sensibly circular, and the velocities of the components 163 and 199 km. per sec. respectively, that of the primary being the highest so far known with the exception of β Lyræ, V Puppis, and μ^1 Scorpii. The star is of further interest as an additional case in which the K line of calcium indicates a velocity differing from that given by other lines of the spectrum. The mean velocity differs so little from that of the system, -5 km., that it suggests an origin of the line in the system itself. If the line were due to absorption by a calcium cloud stationary with respect to our stellar system, its velocity due to the solar motion would be -16 km. The individual plates show considerable variations, but these are apparently unrelated to the oscillations of the component stars.

Banded Spectra from the Electric Furnace.—At the Mount Wilson laboratory Dr. A. S. King has investigated the conditions of occurrence in the electric furnace of the banded spectra which have been attributed to titanium oxide, magnesium hydride, and calcium hydride (*Astrophysical Journal*, vol. xliii., p. 341). All the bands in question have been identified in the spectra of sun-spots, and those of titanium oxide are the most characteristic feature of the spectra of Antarian, or third-type, stars. The outcome of Dr. King's experiments on titanium is to confirm the conclusion previously arrived at by Fowler, that the bands attributed to the oxide of this element are certainly dependent upon the presence of oxygen, and to show that with a sufficient supply of oxygen in the furnace the spectrum consists of the bands alone. There was no evidence of a material change in temperature caused by the introduction of oxygen, and there would seem to be no reason for the disappearance of the line spectrum unless an actual compound were formed. In the case of magnesium and calcium, the experiments similarly indicated a clear dependence of the bands on the presence of hydrogen, without any apparent change in the action of the source. While the bands appeared through a considerable range of furnace temperatures, the upper limit for their greatest strength was about 2300° C. There would accordingly seem to be ample justification for regarding the presence of the three sets of bands as evidence of a relatively low temperature in sun-spots, and the occurrence of titanium-oxide bands as direct evidence of the presence of oxygen in the Antarian stars and in the sun.

THE WORK OF THE NATIONAL PHYSICAL LABORATORY DURING THE YEAR 1915–16.

THE report of the National Physical Laboratory for the year 1915–16 again presents a record of useful national work. The importance of the laboratory has been rendered more prominent owing to the war, not only because of the direct assistance it has been called upon to give to the Services, but also through its co-operation in the solution of industrial problems which our blindness and lack of national prudence has been content to leave unattempted, an open field wherein the scientific and technical organisation of Germany might find its reward.

Two prominent members of the general board of the laboratory, Sir Frederick Donaldson and Mr. Leslie Robertson, lost their lives, in their country's service, on the *Hampshire*. The board have put on record in the report their appreciation of the services rendered to the laboratory by these members of their body. Sir Frederick Donaldson was an active member also of the executive committee. Mr. Leslie Robertson, from the nature of his duties as secretary to the Engineering Standards Committee, had been closely associated for many years with the work of standardisation and maintenance of standards, which constitutes one of the main functions of the laboratory.

Last year the laboratory had also to mourn the loss of two of its earliest and most active supporters, Sir Andrew Noble and Sir Arthur Rücker, both members of the Treasury Committee, presided over by Lord Rayleigh, which in 1897 reported in favour of the establishment of the laboratory.

One-quarter of the permanent staff of the laboratory are at present on active service. Two who served in France have lost their lives. One, taken prisoner at Antwerp, succeeded about a year later in escaping from Döberitz. During the past year the services of all away have been much missed, and it has been necessary to provide a constantly increasing temporary staff, including many women, of whom it is recorded that their work has been very efficiently done.

Owing to the depletion of the staff and the large demands made on the laboratory by the Admiralty, the War Office, and the Ministry of Munitions for the investigation of special questions, the research work has necessarily suffered, and in many departments has been altogether in abeyance. On the formation of the Ministry of Munitions, Dr. Glazebrook, the director of the laboratory, was appointed its scientific adviser on physical questions. The laboratory undertook the testing of gauges required in the manufacture of fuses and shells. The initial difficulties were considerable: the degree of accuracy needed in the gauges was scarcely realised at first by many of the numerous manufacturers who gave their assistance to the Ministry in meeting the needs of the Army, and the laboratory has earned their confidence and appreciation by the valuable help it has been able to give, both directly and indirectly, in the improvement of the methods employed.

The war has lent a great stimulus to the production in this country of optical glass, an industry which had previously tended more and more to become a German monopoly. The shortage in the early months of the war must have been a source of most serious anxiety to those responsible for the supply of optical munitions, and it is a matter for congratulation that the difficulty has been met so successfully. Research on optical glass has now been undertaken by the laboratory, with the aid of a grant from the Privy Council Committee for Scientific and Industrial Research. This work is of the utmost national and scientific im-

portance, and the committee will doubtless spare no effort to ensure that it is actively continued and extended, and that in the future no risk shall be run of this fundamentally important industry passing into foreign hands. Research on chemical and other glasses has been done during the year by the laboratory, as well as by other institutions.

As is well known, one of the principal difficulties in the manufacture of optical glass lies in the choice of suitable refractory material for the pots in which it is made. The report states that the research has so far been mainly directed to the production of satisfactory pots, and that similar work on heat-resisting materials, and more generally on the behaviour of the rare earths and other substances at high temperatures, is of great importance in a large number of industrial processes. For such work a technological laboratory on a large scale is needed; and notwithstanding the economic difficulties existing, it is to be hoped that the matter will receive immediate and serious consideration.

The laboratory has earned a world-wide reputation for its successful investigation of some of the more difficult questions in aeronautics. The immediate importance of the work to the Army and the Navy has led to large additions to the equipment for aeronautical research, for which new buildings have been provided during the year; in these a second 7-ft. and a second 4-ft. channel have been installed. The laboratory has now five air-channels, as well as a whirling table, available for experiments on models, and with a greatly increased staff has been continuously occupied in dealing with the questions constantly arising in connection with the design of new types of machine. In the investigation of light alloys and materials of construction a large field of work remains open, and it is satisfactory to learn that this branch of the work is receiving increased attention on an extended scale.

Provision for other new work has been rendered possible through a timely gift from Sir Charles Parsons. Arrangements have been made, at the request of the Röntgen Society, for the examination of materials employed for the protection of X-ray workers. The equipment has been installed, and the conditions of test are being determined in conjunction with the Council of the Röntgen Society.

By desire of the Ministry of Munitions, arrangements were made for the testing of prismatic compasses in considerable numbers. A paper describing the methods employed was read before the Optical Society. Assistance has been given to the Board of Trade in preparing a specification of liquid compasses for use on the lifeboats of merchant ships. The examination of the luminous dials fitted on instruments for night use constitutes an important branch of new test work, involving also the examination of the luminous radium compounds employed. Tests of radium preparations have been continued, and further improvements have been made in the methods of testing optical pyrometers, which are now being manufactured in increasing numbers in this country.

Turning to work which falls more appropriately under the heading of research, an investigation has been made into methods of magnetic testing of straight and curved bars, and improvements effected. The work has been described in a paper presented to the Institution of Electrical Engineers. A research on magnet steels is in progress. In the heat division an appreciable amount of work has been done in the investigation of the thermal conductivity of various substances, both refractory materials for furnace construction and materials employed for cold-storage work. The rate of heat transmission through roofing materials has also been investigated, and found to depend to a much greater degree upon the emissivity of the surface than on the rate of conduction through the material. The loss of heat through special roofing material was thus found to be 20 per cent. greater than that through galvanised iron, owing to the difference in surface emissivity. When the special material was painted with aluminium paint, the transmission became practically identical with that of the sheet iron. Other experiments on heat loss from surfaces have been continued, and an investigation has been conducted into the qualities of British-made porcelain for pyrometer tubes.

In the Optics Division, tables for the construction of small telescope objectives from glasses of usual types have been prepared and published at the request of the Ministry of Munitions, and the results of continued experience and investigation in the design and calculation of lens systems have been communicated to the Physical Society in a series of papers. Another investigation relates to the improvement of hydrogen vacuum tubes for use in the examination of optical glasses.

The Metrology Division has been closely occupied with special test work. Some work relating to the sizes of commercial sparking plugs and tapped holes for motor engines has been carried out for the Engineering Standards Committee.

In the Engineering Department progress has been made with a number of researches. A new machine has been constructed for testing the endurance of specimens under combined bending and twisting. The methods of notched-bar impact testing have been investigated; various methods for testing the hardness and wearing properties of metals have been compared, and experiments have been carried out on the resistance of wood to reversals of stress. Shock tests on railway couplings have been made. The measurement of the rate of growth of cracks in the Tower of London is a matter of general public interest. In Aeronautics the investigation of stability has been extended to the case of curvilinear motion.

In the Metallurgy Department, investigatory work has been mainly confined to matters of immediate importance; some interesting papers relating to appliances for metallurgical research have been read before the Institute of Metals. Valuable papers have been contributed to various institutions by members of the staff of the Froude Tank, which has, however also been occupied almost entirely with urgent work for the Admiralty.

The report makes it clear that the laboratory has borne its full share of the burden which has fallen upon the nation, and the country is indebted to the director and his staff for their strenuous efforts in the furtherance of technical efficiency.

THE RECENT DEVELOPMENT OF GERMAN AGRICULTURE.

THE fact that on each hundred acres of cultivated land Germany feeds seventy of her people whilst Britain can only support forty-five has rightly received wide publicity in the daily Press. The memorandum by Mr. T. H. Middleton, Assistant-Secretary, Board of Agriculture and Fisheries, which explains how Germany does this, should be studied by all who have the welfare of British agriculture at heart. The two chief factors in the recent remarkable development of German agriculture are her settled economic policy and her well-thought-out system of agricultural education. It was the belief that he was essential to the community, and that his land would not be allowed to go out of cultivation, rather than the extra pro-

on his wheat, that has inspired the German farmer to greater efforts during the last ten years. The need for well-educated men as managers of estates is more commonly recognised in Germany than in England; hence a career is open to successful students from the training institutions of Prussia, while the English student who lacks the capital to farm on his own account must look abroad for an outlet for his knowledge of practical agriculture.

Mr. Middleton believes that our system of education, though starting thirty years behind that of Germany, mainly wants time to grow. It is unfortunate that it had only just started before the war and that results will be sought at a time when patience will be necessary but very difficult to exercise. The chief immediate cause of the increased productivity of German soil is the increase in the use of artificial manures. The German farmer is no more skilful than the British, but his natural obedience to authority leads him to apply artificial manures in such quantities as his instructors, relying on the systematic work of the experiment stations, may from time to time direct. Twice as much nitrogen, one-third more phosphate, and five times as much potash are used in Germany as on an equal area of our cultivated land. As regards the two former manures, we import nearly three tons more feeding stuffs per one hundred acres than the Germans, and this should balance to some extent the smaller amounts of nitrogen and phosphate applied direct to the soil; but careless storage of farmyard manure results in the loss of some 50 per cent. of the nitrogen and a good deal of the phosphate, so that far less than the theoretical amount ever gets to the growing crop. Germany is fortunate in that she has not only immense deposits of potash salts, but also vast areas of light soils able to give abundant returns from these manures when skilfully applied. This combination plays an important part in the recent progress of German farming.

THE ROYAL AIRCRAFT FACTORY INQUIRY.

THE whole question of the Royal Aircraft Factory administration and cost seems to turn on whether it is to be regarded as an experimental or a productive concern. If it is to be regarded as a factory for the production of service machines, then there is little doubt that it is not administered as efficiently as it might be. But if it is to be regarded as a purely, or at least chiefly, experimental establishment, then the case is completely altered. In the development of a new industry, such as aeronautics, there must be a certain amount of experiment, and in modern times the tendency is to arrive at a satisfactory result by the application of science to the fullest possible extent, rather than to attain that result by a lengthy process of trial and error. The inevitable result of the scientific method is that it appears as though a considerable amount of money is being wasted with no appreciable result, but in reality the money is being well spent if it leads to scientific results of a widely useful nature. The Royal Aircraft Factory should therefore be judged by its achievements in the advance of aeronautical science rather than by its actual output of machines for service use. There can be no doubt at all that the work done at the factory, in conjunction with the model experiments and mathematical investigations at the National Physical Laboratory, has elucidated many questions of vast importance concerning the design and stability of aeroplanes in a way which would perhaps never have been done by private firms, where output is the primary consideration. Once it is admitted that this scientific information is needed, the Royal Aircraft Factory stands justified by its past work. By all means reorganise, if by such reorganisation increased efficiency can be obtained, but let it not be at the expense of the exceedingly valuable experimental work which is being done, and which can be done in no other way at the present time.

It is often argued that private firms can produce machines equal to those of the Factory, without spending so much time and money on the experimental side. This is by no means true, since the results of such experimental work at the Factory and elsewhere have always been available to a large extent to any who cared to avail themselves of them, and many good points in proprietary machines are indirectly due to this fact. There is still an inclination on the part of some firms to view the scientific side of the subject with suspicion, and even to depreciate experimental aeronautics altogether, but surely the sooner experimental results become more widely known the better it will be for the future development of the aeronautical industry. In the provision of these scientific fundamentals of aeronautics the Royal Aircraft Factory has played, and is playing, an important part, and any attempt at reorganisation which would impair its utility as an experimental establishment, and reduce it to the level of a productive factory for existing designs, would be a great mistake at the present early stage of aeronautical development.

LORD KELVIN AND TERRESTRIAL MAGNETISM.[1]

LIKE most branches of physics, terrestrial magnetism has associations with the name of Kelvin, and, characteristically enough, these associations are at the two confines of the subject, the immediately practical, and the speculative. Lord Kelvin, I need scarcely remind you, introduced important changes of design into compasses, and the construction of compasses was an important object of the Glasgow firm which eventually bore his name.

The other point of contact between Lord Kelvin and terrestrial magnetism, as already mentioned, relates to theory. All here know that there occur from time to time phenomena known as magnetic storms, during which there are difficulties in carrying on ordinary telegraphy. There has long been a belief that the sun is the principal, if not the only, source of magnetic storms, and of the less striking regular changes every day visible. Lord Kelvin directed attention to the difficulties in the way of accepting any sensible *direct* magnetic action between the sun and the earth. His earliest remarks on the subject, to which I shall refer, are contained in a short note on p. 154 of vol. iv. of his "Mathematical and Physical Papers." "The sun's magnetisation," he said, "would . . . need to be 120 times as intense as the earth's to produce a disturbance of 1′ in declination even by a *complete reversal* in the most favourable circumstances."

The much later communication, to which I next refer, was made in 1892 to the Royal Society, on an occasion—a presidential address—when original contributions to science are unusual. Lord Kelvin, however, devoted fully half his address to terrestrial magnetism. After referring to various solar and terrestrial magnetic phenomena he adds (*loc. cit.*, p. 307):—"But now let us consider . . . the work which must be done at the sun to produce a terrestrial magnetic storm." He then quotes from a paper by the late Prof. W. G. Adams data relating to a magnetic storm of June 25, 1885, and proceeds:—"To produce such changes as these by any possible dynamical action

[1] Abridged from the Seventh Kelvin Lecture delivered before the Institution of Electrical Engineers on February 17, by Dr. C. Chree, F.R.S.

within the sun, or in his atmosphere, the agent must have worked at something like 160 million million million million horse-power. . . . This result, it seems to me, is absolutely conclusive against the supposition that terrestrial magnetic storms are due to magnetic action of the sun; or to any kind of dynamical action taking place within the sun, or in connection with hurricanes in his atmosphere, or anywhere near the sun outside. It seems as if we may also be forced to conclude that the supposed connection between magnetic storms and sun-spots is unreal, and that the seeming agreement between the periods has been a mere coincidence. We are certainly far from having any reasonable explanation of any of the magnetic phenomena of the earth; whether the fact that the earth is a magnet; that its magnetism changes vastly, as it does from century to century; that it has somewhat regular and periodic . . . solar diurnal . . . variations; and (as marvellous as the secular variation) that it is subject to magnetic storms."

To-night I shall confine myself to three of the outstanding problems enumerated by Lord Kelvin: the secular change, the solar diurnal variation, and the phenomena of magnetic disturbances.

Secular Change.

Our knowledge of secular change prior to the nineteenth century is confined to declination and dip. For these elements we have in some districts data covering more than three centuries.

The total range of D (declination) observed in London has exceeded 35°. The only actual turning point observed, 24·6° W., presented itself about 1818, the direction of secular change then altering from westerly to easterly. We have no idea how the value, $11\frac{1}{4}$° E., observed in 1580 stood to the previous turning point. The declination was approximately the same as at present in 1730. When, if ever, it will have the same value again, we have not the ghost of an idea. The change in each of the centuries 1600 to 1700 and 1700 to 1800 was about 16°, whereas during the last hundred years the change has been only about 9°. The rate of change has, however, markedly increased of late years, as may be recognised on consulting Fig. 1, which shows the change at Kew during the last fifty years.

The turning point in the dip, when it attained its highest value, presented itself about 1723, or nearly a century before the turning point in D. The dip in London is now lower than it has been since observations began. Of late years the rate of change has been very small, but whether this heralds the near approach of a minimum, or is merely a temporary slackening, we do not know.

The intensity of magnetic force changes as well as the direction. Thus at Kew between 1890 and 1900 H (horizontal force) increased from 0·18169 to 0·18428 c.g.s. When dealing with such small changes as ordinarily present themselves in terrestrial magnetism, it is convenient to employ as unit 1γ, or 0·00001 c.g.s. Thus the mean annual rise of H from 1890 to 1900 was 26 γ. After 1900 the rate of increase of H rapidly fell off, and the element seems to have attained a maximum and begun to diminish. V (vertical force) has been diminishing for some time.

Diurnal Variation.

To give a full account of the diurnal variation as it presents itself at different parts of the earth would require a large treatise. Here I shall confine myself to data from two stations, and to certain aspects only of these data. The one station, Kew, is fairly representative of the British Isles. The other station is that used in 1911–12 as the base station of the National Antarctic Expedition under the late Captain Robert Falcon Scott, R.N. The reduction of the Antarctic observations has been prosecuted at Kew Observatory for the last two years under my supervision. For permission to make a free use of existing data I am indebted to the committee of the Captain Scott Antarctic Fund.

The tragic fate of Captain Scott is still no doubt fresh in your memories. It produced a great impression on his countrymen, who saw in it evidence that the characteristics on which the nation prided itself in more warlike times still survived. The appreciation of courage is practically universal, but even a scientific audience may have to be reminded that the prosecution of pure science under the arduous conditions prevailing in the Antarctic calls for no small measure of pluck and endurance. It also calls, if success is to be attained, for other qualities, which though making less appeal to the public imagination, are perhaps of equal value for the welfare of a nation, viz., scientific knowledge and forethought. If I am able to-night to mention important deductions from the Antarctic observations, it is to the physical observers, Dr. Simpson, F.R.S., and Mr. C. S. Wright, that recognition is in the first place due. In spite of the great difficulties arising from the low temperature and the extraordinarily disturbed magnetic conditions, they secured an almost unbroken record for a period of nearly twenty-two months.

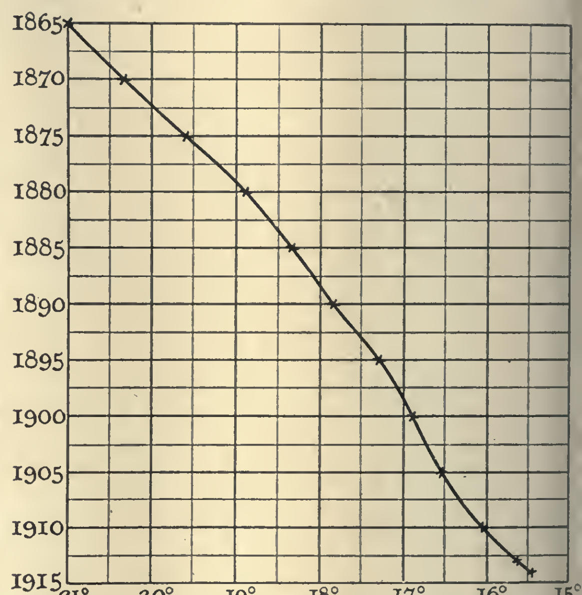

FIG. 1.—Changes of westerly declination at Kew since 1865. Change in the last fifty years $5\frac{3}{4}$°. Present annual change 9′.

In Fig. 2 the vector diagrams refer to mean results from the whole year. The full-line diagram represents at either station results based on all, or all but highly disturbed days, the dotted-line diagram results from quiet days only, the origin, the centre of the cross, being the same for the two. The Antarctic quiet days (selected by myself) were ten a month, as against five at Kew (international quiet days). Thus *a priori* we should have expected less difference between the two Antarctic diagrams than between the two Kew ones. As regards type, there is, in fact, less difference in the Antarctic, but as regards amplitude the difference at Kew is slight, and not always in favour of the all-day vector, whereas in the Antarctic the excess of the all-day vector is conspicuous at every hour.

The great difference in amplitude between the Antarctic diurnal inequalities from all and from quiet days suggested a comparison between inequalities from highly disturbed days, on the one hand, and quiet days on the other. To secure a demonstrably impartial selection, I took for each month the five international quiet days selected at De Bilt and the five days which had the largest "character" figures on the international list. "Day" in this connection means a period of twenty-four hours commencing at Greenwich midnight. Thus Greenwich civil time has been used in the curves in Fig. 3, which embody the results obtained for the two sets of days in the Antarctic. When comparing Antarctic results in Figs. 2 and 3, it must be remembered that 11h. on the former answers to 0h. on the latter.

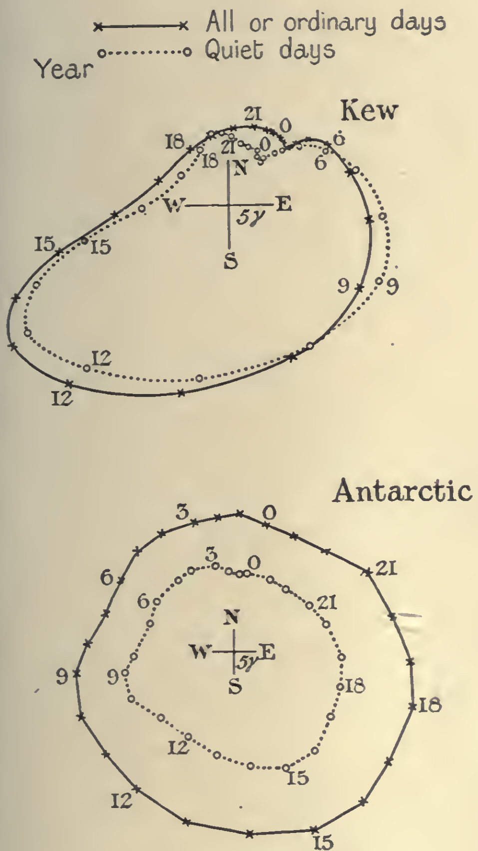

Fig. 2.—Diurnal variation.

Fig. 3 is confined to the four midwinter months, May to August.

Large as was the difference between the all and quiet-day vectors in Fig. 2, it is quite eclipsed by the difference between the disturbed and quiet-day vectors in Fig. 3. In the latter figure the amplitude of the disturbed-day vector averages about four times that of the quiet-day vector. In fact, the vector for the disturbed winter day averages about the same as the vector of the ordinary summer day.

While opinions may differ as to what the phenomena shown by Figs. 2 and 3 really imply, it can scarcely be questioned that they have an important bearing on theories which attempt to account for the diurnal variation. A difference in type between simultaneous diurnal inequalities at different places is a natural enough consequence of difference of geographical position. But the influence of disturbance is out of all proportion greater in the Antarctic, and presumably also in the Arctic, than in the temperate latitudes of Europe, and no mathematical formula which contains only geographical co-ordinates and sun's position can adequately meet the case of diurnal inequalities the ratio of the amplitudes of which at different places varies from day to day according to the prevalence of disturbance.

The 27-Day Period.

A remarkable feature in magnetic disturbance is the so-called 27-day period. This seems to have been first noticed by J. A. Broun [2] in 1858, but the phenomenon for some reason was practically overlooked until rediscovered by W. Maunder [3] in 1904 in Greenwich magnetic storms, and about the same time or a little earlier by A. Harvey [4] in Toronto disturbances.

All I think we are really entitled to say is that if a certain day is disturbed, days from twenty-five to thirty days later have more than the usual chance of being

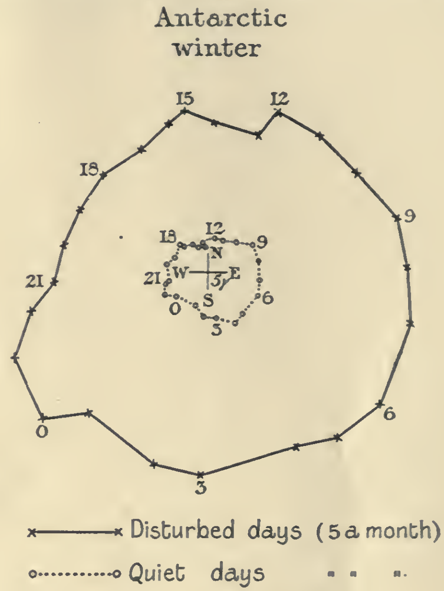

Fig. 3.—Diurnal variation.

disturbed, and this probability is greater for the twenty-seventh day than for the twenty-sixth or twenty-eighth.

If we confine our attention to large magnetic disturbances an obvious difficulty arises. Large disturbances are rare, and if all but large disturbances are disregarded, a very inadequate supply of data remains. If, on the other hand, we count a large number of disturbances as magnetic storms, numerous chance repetitions in twenty-seven, or any other specified number of days, must be expected; and in the absence of any precise definition of what constitutes a storm—and none commands general respect—claims as to repetitions in twenty-seven days naturally fail to carry conviction. There are, however, ways of testing the existence of the period less exposed to criticism, and those I have tried point to the real existence of a 27-day period in a certain sense of the term.

The first thing is to get what will be generally accepted as an impartial measure of disturbance, so that days may be selected as representative of dis-

2 *Philosophical Magazine*, August, 1858.
3 R.A.S. Notices, vol. lxv., pp. 2 and 538, etc.
4 Proceedings of the Royal Astronomical Society of Canada, 1902-3, p. 74.

turbed conditions, and every day may have a numerical measure attached to its disturbance. International "character" figures naturally suggest themselves for the purpose.

The "character" figures were entered in successive columns, representing from so many days before to so many days after the representative disturbed day. The successive columns were summed, and the resulting means taken as a measure of the average disturbance presented from so many days before to so many days after the representative day.

The days recognised by Maunder as magnetic storms average only about one a month, and were much more numerous in some years than others. If the 27-day period had been a phenomenon confined to such highly disturbed days, the procedure adopted here could scarcely have brought it into evidence, except in disturbed years. It proved, however, to be as much in evidence in the less disturbed as in the more disturbed years. This suggests that it is not peculiar to disturbed conditions, a conclusion which is strongly supported by Fig. 4, which shows the results of applying the procedure explained above to the international quiet days as well as to the representative disturbed days of the nine years 1906 to 1914. The representative days in each category were five a month. The normal line in Fig. 4 represents the mean "character" figure, 0·60₄, of all days of the nine years. Above this normal line we have the primary and secondary pulses associated with the representative disturbed day, the "character" figure of which was 1·26, and below it are the primary and secondary pulses associated with the representative quiet day, the "character" figure of which was 0·11. The secondary pulse associated with the representative quiet day is not quite so deep as that associated with the representative disturbed day, but the same is true and to a like extent of the primary pulses.

The graphical representation of the results for the individual years in Fig. 4 is confined to days 0 and 27. The extreme top and bottom of the lines represent the "character" figures on the representative disturbed and quiet days, on the same scale that serves for the nine years combined. The top and bottom of the thickened portions of these lines represent the "character" figures on the days which are twenty-seven days subsequent to the representative disturbed and quiet days respectively. The total length of the vertical line may be regarded as a measure of the primary difference pulse (disturbed less quiet), and the length of the thickened portion as a measure of the corresponding secondary pulse. The short horizontal line shows the "character" level of the average day of the year. The lengths of thickened line above and below this level may thus be regarded as representing respectively the amplitudes of the secondary pulses of disturbed and quiet conditions. Above the nine lines are given Wolfer's mean sun-spot frequencies for the respective years.

The 27-day period is conspicuously shown in Fig. 4 in every year except 1914, where the secondary pulse associated with the representative disturbed day is abnormal. The two years in which the 27-day period is most in evidence are 1911 and 1913, both, especially the latter, years of few sun-spots; while 1907, the year of sun-spot maximum, shows it less than any other year except 1914. In 1912 the secondary disturbed pulse is much better developed than the secondary quiet pulse, and 1913 shows the same phenomenon to a minor extent. In 1906, on the other hand, the secondary quiet pulse is the more prominent. In the years 1907 to 1911 the development of the two secondary pulses is very similar.

A good deal probably remains to be done to unravel the exact nature of the relationship between sun-spots and magnetic phenomena. There can scarcely be any doubt that the range of the mean diurnal variation for the whole year varies from year to year in almost exactly the same way as the mean sun-spot frequency or the sun-spot area. Also the two phenomena exhibit a 27-day period, and to approximately the same extent. In the average year of an 11-year period, 1890 to 1900, the daily range of H at Kew showed a decided tendency to be above its mean value during several successive days subsequent to the appearance of exceptionally large sun-spot area, the maximum in the range following four days after the maximum in the area. The phenomenon, however, did not seem to arise from special disturbance, but rather to be a variant of the phenomenon of large regular diurnal

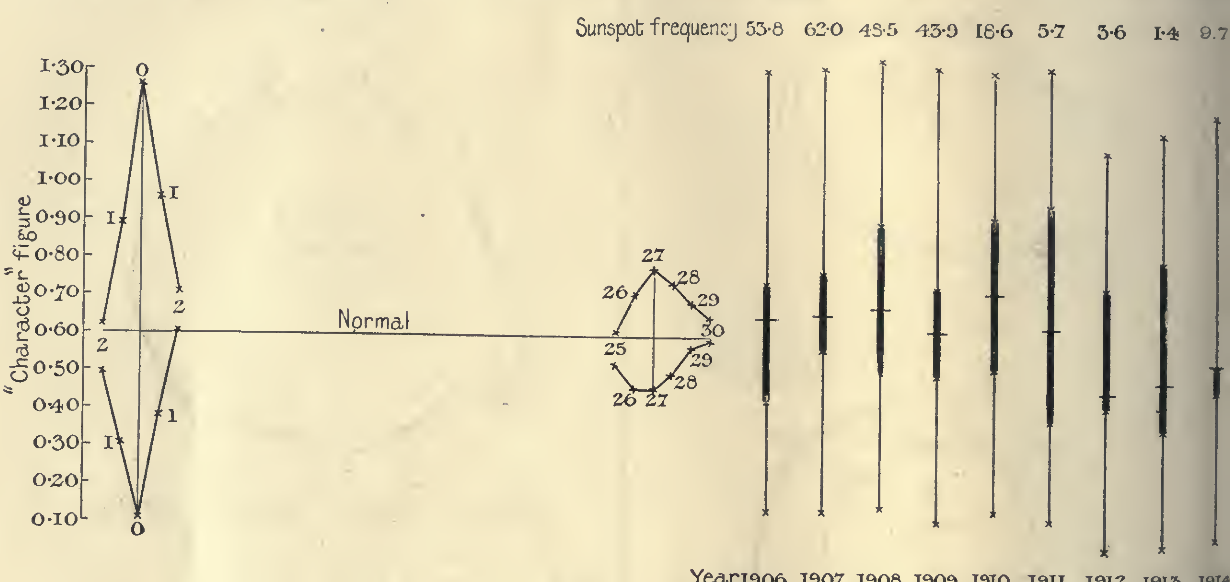

FIG. 4.—27-day period. International "character" figures 1906 to 1914.

variation in years of many sun-spots. As regards disturbance, in some years there seems a clear connection with sun-spots, in others little, if any. This is what we might expect to happen if the 27-day periods in the two elements in one year tended to be in phase, and in another year did not. But the 27-day period may be prominent in magnetic phenomena in years when there are almost no sun-spots. Also the 27-day period is exhibited by magnetic calms as well as by magnetic storms, and no one has suggested that limited solar areas can exercise a calming influence on terrestrial magnetism.

On the question naturally of most interest to my audience, whether terrestrial magnetism has any direct bearing on the problems of electrical engineering, a few words must suffice. If wireless phenomena are affected, as has been suggested, by the greater or less conductivity of the upper atmosphere, one would expect them to have certain features in common with magnetic phenomena. In particular, the 11-year period and the 27-day period might be expected to disclose themselves. If these periods affect wireless to anything like the same extent as they do terrestrial magnetism, there should be no great difficulty in establishing the fact, if systematic observations were directed to that end. Another possibility is that means may be developed for utilising some of the power that now goes to magnetic storms. This would naturally be most feasible in high latitudes where aurora and magnetic disturbance are most in evidence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

WE learn from the *British Medical Journal* that Prof. Charles Richet, of the University of Paris, has been awarded the State prize for poetry. The subject was "The Glory of Pasteur."

EXAMINATIONS in biological chemistry, bacteriology, fermentation and enzyme action, and in chemical technology will be held in connection with the Institute of Chemistry in October next. The lists of candidates will close on September 12.

DR. A. LAUDER, of the Edinburgh and East of Scotland College of Agriculture, has been elected honorary secretary of the Edinburgh and East of Scotland section of the Society of Chemical Industry, in succession to Dr. J. P. Longstaff, now general secretary of the society in London.

MISS S. E. S. MAIR and Mrs. A. M. Chalmers Watson, on behalf of women medical graduates, students, and their friends, have offered to pay to the Edinburgh University Court within a year the sum of 4000*l.* to defray the cost of undertakings intended to facilitate the medical education of women.

THE following Edgar Allen entrance scholarships are being offered by the University of Sheffield:—Two open to men and women, and two restricted to the "sons of workmen earning daily or weekly wages and foremen of workmen and managers." Each scholarship is of the annual value of 100*l.*, and is tenable for three years.

THE part of the forthcoming calendar for 1916–17 of University College, London, dealing with the faculty of engineering has been published in advance as a booklet. This faculty, including the departments of civil, mechanical, electrical, and municipal engineering, is intended to provide for students wishing to devote themselves to engineering as a systematic training in the application of scientific principles to industrial purposes. The courses of work are suited to the requirements of students who intend to enter for appointments in the Indian Public Works Department, Engineering Department of the General Post Office, Department of the Director of Engineering and Architectural Works in the Admiralty, Patent Office, and other similar services. Facilities are provided also in the engineering departments for postgraduate and research work in all subjects of engineering. The more important engineering institutions grant various exemptions to holders of the different certificates awarded by the college. All communications from intending students should be addressed to the Provost.

THE calendar for the session 1916–17 of the North of Scotland College of Agriculture is now available. The classes of the college are held in the buildings of the University of Aberdeen, except those in agricultural engineering, which are held at Robert Gordon's Technical College. The college farm at Craibstone, about five miles from Aberdeen, includes experimental plots, an experimental and demonstration garden, and a horticultural department. Field experiments and demonstrations are carried out on ordinary farm crops. Feeding and other experiments upon stock are conducted, and there are extensive woods, including both conifers and hardwood trees, on the estate, which are being utilised for the purposes of the forestry department. It is proposed to institute a school of rural domestic economy for girls. There is a large mansion-house on the Craibstone estate which will be equipped as a residence in which classes will be carried on. It is proposed to provide courses of instruction suitable for those who intend to spend their lives on farms and crofts. For the instruction of classes in nature-study and school gardening, two acres of ground at Kepplestone, Rubislaw, have been laid out as a demonstration garden.

THE valuable series of papers on the better co-ordination of science and industry read during the last six months before the American Chemical Society was followed by the appointment of a committee, who have now presented a report based on the examination of the subject from three different points of view, viz. those of the university, of the industries, and of the consulting chemists. The report is classified under findings, conclusions, and a single recommendation to the effect that a permanent central committee should be created and appointed by representatives of the universities and the industries to study opportunities and make public recommendations. The distinction is drawn between industrial problems which are common to specific industries, so that research on them can be carried out in universities and published, and those problems which cannot properly be published, and are, therefore, not adapted to university treatment. On the other hand, the industries are asked to make known to the universities problems which are not of sufficient importance to the industry to undertake their solution directly so that the universities can use them as live material on which the students can be trained. The recognition by the university that the industry alone is in a position to state its problems, and by the industry that it should be prepared to give the necessary financial assistance to the university to investigate these, is an important step towards the desired co-ordinated effort. It is pointed out that no matter how efficiently the university may train its men, the industries that take up such men must be prepared to expend much time, effort, and money in training them for the specific work before them, but it is agreed that co-operation between the university and the works as to the requirements of the latter in the fundamentals of instruction seems possible, feasible and mutually profitable. The findings deal with certain controversial points in the education

of the technical chemist. For example, the part-time system whereby the summer vacation is spent in the industry is condemned; the value of industrial fellowships is regarded as diminishing as the liberty to publish is restricted. The report is eminently practical, and it will well repay serious consideration in this country.

SOCIETIES AND ACADEMIES.

Manchester.

Literary and Philosophical Society, May 30.—Prof. W. W. Haldane Gee, vice-president, in the chair.—Dr. W. H. R. **Rivers**: Irrigation and the cultivation of taro. In the New Hebrides and New Caledonia irrigation is only used for the cultivation of *Colocasia antiquorum*, the taro of the Polynesians. This intimate connection between irrigation and taro, which is found in other parts of Oceania, suggests that if irrigation belongs to the megalithic culture (W. J. Perry, Manchester Memoirs, vol. lx., part i.), taro must have had a similar history. The distribution of the plant supports this suggestion, showing a close correspondence with that of the megalithic culture when its tropical and semi-tropical habits are taken into account. It occurs in Oceania, the Malay Archipelago, India and eastern Asia, Arabia, Egypt, East and West Africa, the Canary Islands, Algeria, southern Italy, Spain and Portugal, as well as tropical America. Since the original habitat of the plant is southern Asia, its use as a food was probably acquired by the megalithic people in India and taken by them both to the east and west. Although the general distribution of taro in southern Melanesia corresponds with that of the megalithic influence, a difficulty is raised by the island of Malekula, in the New Hebrides. So far as we know, irrigation does not occur in this island, although megalithic influence is present in a very definite form. To account for the absence of irrigation in this island it is shown that modes of disposal of the dead point to two megalithic intrusions into Oceania, and the high degree of development of irrigation in such outlying islands and districts as New Caledonia, Anaiteum, and north-western Santo in Melanesia, and the Marquesa and Paumotu Islands in Polynesia, suggests that this practice belonged to the earlier of the two movements. There is reason to believe that this movement had relatively little influence in Malekula.—Prof. G. Elliot **Smith**: The arrival of *Homo sapiens* in Europe. At a time when little was known of early man and his works beyond the stone implements which he fashioned, Sir John Lubbock (afterwards Lord Avebury) suggested the use of the terms Palæolithic and Neolithic to distinguish respectively between the earlier part of the Stone age, when crudely worked implements were made, and the later period, when more carefully finished workmanship was shown. In spite of the fact that subsequent investigation revealed a high degree of skill in the craftsmanship of the Upper Palæolithic period, which in many respects shows a very much closer affinity to the Neolithic than to the Lower Palæolithic period, Lubbock's terminology has become so firmly established that it has continued to determine the primary subdivision into epochs of the early history of man. Recent research has brought to light a vast amount of new information relating to the achievements of Upper Palæolithic man, and has conclusively shown that human culture and artistic expression had already attained the distinctive characters which mark them as the efforts of men like ourselves. This view has been amply confirmed by the general recognition of the fact that, after the disappearance of Neanderthal man at the end of the Mousterian period, the new race of men that supplanted them in Europe and introduced the Aurignacian culture conform in all essential respects to our own specific type, *Homo sapiens*. Thus the facts of physical structure, no less than the artistic abilities and the craftsmanship, of the men of the Upper Palæolithic proclaim their affinity with ourselves. The earlier types of mankind which invaded Europe and left their remains near Piltdown, Heidelberg, and in the various Mousterian stations belong to divergent species, and perhaps genera, which can be grouped together as belonging to a Palæanthropic age, which gave place (at the end of the Mousterian epoch in Europe) to a Neoanthropic age, when men of the modern type, with higher skill and definite powers of artistic expression, made their appearance and supplanted their predecessors. So long as primary importance continues to be assigned to the terms Palæolithic and Neolithic, the perspective of anthropology will be distorted. Though the facts enumerated in this communication are widely recognised, it is found that the writers who frankly admit them lapse from time to time into the mode of thought necessarily involved in the use of the terms Palæolithic and Neolithic. If modern ideas are to find their just and unbiassed expression some such new terminology as is suggested here becomes necessary.

Paris.

Academy of Sciences, July 31.—M. Ed. Perrier in the chair.—At the preceding meeting of the Academy the president, in announcing the death of Sir William Ramsay, gave an account of his work in chemistry.—J. **Bergonié** and C. E. **Guillaume**: Surgical instruments adapted to the field of the electro-vibrator. Ordinary surgical instruments utilised in the field of the electro-vibrator are, like the projectile sought for, submitted to an intense oscillatory movement, a matter of difficulty for the surgeon. To reduce this vibration to negligible proportions, it is necessary that the instruments should be constructed of a metal non-magnetic and of high resistivity. The iron-nickel alloys, containing between 22 per cent. and 30 per cent. of nickel, fulfil these conditions, but offer difficulties in manufacture. Another group of alloys suitable for this purpose contains 90 per cent. nickel, the remaining 10 per cent. consisting of chromium, manganese, and a little copper. Such an alloy, under the name of baros, has been used for some years for weights of precision, and fulfils all the conditions of the present problem; it works like mild steel, is practically unoxidisable, and is free from action in the field of the electro-vibrator.—R. **Garnier**: Study of the general integral of equation (VI.) of M. Painlevé in the neighbourhood of its transcendental singularities.—H. **Arctowski**: The influence of Venus on the mean heliographic latitude of the sun-spots. The earliest communication on this subject was due to Warren de La Rue, Stewart, and Lœwy in 1867, and F. J. M. Stratton has recently taken up the same question. The author does not think the results of Stratton's calculations can be considered as conclusive, and has made a fresh series of calculations based on the Greenwich heliographic observations. It is difficult to decide from the curves whether the action of Venus is direct or the inverse.—A. **Colani**: The oxalates of uranyl and potassium.—C. **Zenghelis**: The composition and use of Greek fire.—F. **Diénert** and L. **Gizolme**: The influence of the algæ on submerged sand filters on the purification of water. The purifying power of these filters is a function of the development and vitality of the algæ, and can be

measured by the reduction of the alkalinity of the water.—J. **Amar**: The dynamographic path. The apparatus described permits of a graphical record being traced of the movement and forces exercised by the limbs in walking. It has been applied to the study of models of artificial limbs, and of pathological cases of injured or missing limbs.—C. **Galaine** and C. **Houlbert**: The removal of flies from houses. The visible part of the spectrum for flies appears to be comprised between the green and the orange. Making use of this fact, coloured glass, especially blue, is suggested for hospitals, and for protecting food in restaurants and shops, without restricting the free access of air.—E. **Fleurent**: A method of preserving bread destined especially for prisoners of war. The method suggested by the author in 1915 has been tried in practice, and its value has been confirmed.—J. **Roubinovitch**: Ocular compression in the examination of the oculo-cardiac reflex.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 7, vol. ii.).—L. B. **Loeb**: The mobilities of gas ions in high electric fields. The results, though at variance with those of most observers at low pressures for negative ions, are in good agreement with recent results of Wellisch, and likewise lead to the conclusion that the "cluster" theory is no longer tenable.—H. H. **Donaldson**: The relation of myelin to the loss of water in the mammalian nervous system with advancing age. There is no evidence that the cell bodies and their unsheathed axons suffer any significant loss of water; the progressive diminution in the water content of the brain and spinal cord is mainly due to the accumulation of myelin, the formation of which is a function of age, the most active production occurring during the first twentieth of the life span.—R. W. **Hegner** and C. P. **Russell**: Differential mitoses in the germ-cell cycle of *Dineutes nigrior*. The most conspicuous difference discovered between the origin of the oocyte in *Dineutes nigrior* and in Dytiscus is in the number of differential mitoses; in *Dineutes nigrior* there are only three, whereas in Dytiscus there are four.—E. S. **Larsen** and R. C. **Wells**: Some minerals from the fluorite-barite vein near Wagon Wheel Gap, Colorado. A description of specimens of the unusual mineral gearksutite, of a peculiar kaolinite, and of a new fluoride-sulphate, creedite.—P. D. **Lamson**: The processes taking place in the body by which the number of erythrocytes per unit volume of blood is increased in acute experimental polycythæmia. It is concluded that the liver acts as a reservoir for erythrocytes. The process by which the liver increases the number of the erythrocytes is thought to be a loss of plasma from the liver capillaries, together with a constriction of these vessels, driving the erythrocytes on into the blood stream.—I. S. **Kleiner** and S. J. **Meltzer**: The influence of morphin upon the elimination of intravenously injected dextrose in dogs. Morphin increases the elimination through the kidneys of intravenously injected dextrose and retards the return of the sugar content of the blood to its previous level.—C. P. **Olivier**: The work of the American Meteor Society in 1914 and 1915. From the 5543 observations of meteors, 139 radiants have been deduced with sufficient accuracy to calculate parabolic orbits for the meteor streams they represent.—A. J. **Dempster**: The light excitation by slow positive and neutral particles. Very slow positive rates are still able to excite light with a speed corresponding to fewer than 5 volts. The neutral rays can also excite light at very slow speeds; the excitation may occur directly because of the collision of a neutral particle with a neutral molecule of the gas.—C. D. **Perrine**: An apparent dependence of the apex and velocity of solar motion, as determined from radial velocities, upon proper motion. The position of the solar apex and of the solar velocity appear to vary with the proper motion of the stars used in the determination. Such variations point ultimately to some form of rotary or spiral motion among the stars.—C. **Barus**: Channelled grating spectra obtained in successive diffractions. A brief abstract of work presented by the author to the Carnegie Institution of Washington.—R. **Pearl**: The effect of parental alcoholism (and certain other drug intoxications) upon the progeny in the domestic fowl. Out of twelve different characters for which there are exact quantitative data, the offspring of treated parents taken as a group are superior to the offspring of untreated parents in eight characters. The results with poultry are in *apparent* contradiction to the results of Stockard and others with mammals, but the contradiction is probably only apparent.—G. H. **Parker**: The effectors of sea-anemones. It seems clear that among the muscles in sea-anemones there are not only independent effectors and tonus muscles associated with nerve-nets, but neuromuscular combinations that exhibit true reflex action.—G. H. **Parker**: Nervous transmission in sea-anemones. There is evidence not only for the assumption of independent receptors, but of relatively independent transmission tracts, a first step in the kind of differentiation so characteristic of the nervous organisation in the higher animals.—G. H. **Parker**: The responses of the tentacles of sea-anemones. The tentacles, in contradistinction to such appendages as those of the arthropods and vertebrates, contain within themselves a complete neuromuscular mechanism by which their responses can be carried out independently of the rest of the animal.—A. van **Maanen**: Preliminary evidence of internal motion in the spiral nebula Messier 101. The mean rotational motion is 0·022″ left-handed; the mean radial motion is 0·007″ outward. There is perhaps a small decrease of the rotational motion with increasing distance from the centre. The annual rotational component of 0·022″ at the mean distance from the centre of 5′ corresponds to a rotational period of 85,000 years.—Symposium on the exploration of the Pacific:—(*a*) W. M. **Davis**: The exploration of the Pacific; (*b*) J. F. **Hayford**: The importance of gravity observations at sea on the Pacific; (*c*) L. J. **Briggs**: A new method of measuring the acceleration of gravity at sea; (*d*) C. **Schuchert**: The problem of continental fracturing and diastrophism in Oceanica; (*e*) J. P. **Iddings**: The petrology of some South Pacific islands and its significance; (*f*) G. W. **Littlehales**: In relation to the extent of knowledge concerning the oceanography of the Pacific: (*g*) C. F. **Marvin**: Marine meteorology and the general circulation of the atmosphere; (*h*) W. H. **Dall**: The distribution of Pacific invertebrates; (*i*) W. G. **Farlow**: The marine algæ of the Pacific; (*j*) J. W. **Fewkes**: The Pacific as a field for ethnological and archæological investigation; (*k*) H. A. **Pilsbry**: Mid-Pacific land snail faunas; (*l*) D. H. **Campbell**: Some problems of the Pacific floras. The symposium contains a summary of some of the results obtained in past exploration of the Pacific and an outline of the importance to many sciences of further systematic and continuous exploration of the Pacific.

CAPE TOWN.

Royal Society of South Africa, June 21.—Dr. L. Péringuey, president, in the chair.—J. D. F. **Gilchrist**: Protective resemblance in post-larval stages of some South African fishes. In *Hemiramphus calabaricus*

the post-larval stages of the fish have the size and colour of fragments of weed, which often are found in the waters which these young fish frequent. When alarmed, the fish become rigid and float about in an apparently inanimate condition. When this occurs, it is difficult to distinguish them from the pieces of weed floating around. In klipfish (*Clinus* spp.) the young are born alive, and they are of a clear, glassy transparency difficult to detect in the water. The contour of the body is probably disguised by a number of minute dark dots. The colour pattern in other young fish is shown to be more marked and considerably different from that of the adult. Some details of this difference are enumerated in the cases of the Jeerfish and the stockfish and a species of dogfish. It is indicated how this colour pattern of the young fish may be a form of protective resemblance.—H. H. W. **Pearson**: Morphology of the female flower of Gnetum. Much work has been done in recent years on the morphology of the flower of the Gnetales, and very diverse views have been put forward. These are discussed, summarised, and compared in this paper, with special reference to recent investigations by the author and to the conclusions of MM. Lignier and Tison, both as published and as discussed in correspondence with the author. Investigations have tended of late to emphasise the Angiosperm characters of the Gnetales, and MM. Lignier and Tison even reach the conclusion that the innermost envelope of the female flower in Gnetum and Ephedra, and of both flowers in Welwitschia, is a plurilocular ovary containing a single naked ovule. They derive their evidence partly from the anatomical structure of the envelope, partly from its form, terminating as it does in "a long style and a stigma." The anatomical evidence they adduce is discussed in detail, and it is shown that the apparent traces of a vascular system do not necessarily prove the envelope to be an ovary, as well-developed vascular systems are present in the ovular integuments of Cycads and a number of the lower Angiosperms. Regarding the resemblance of the envelope to a carpel with style and stigma, it is pointed out that, external appearances to the contrary, there is no evidence that it is a reduced form of a functional stigma. Its present function is to facilitate the dispersal of pollen by attracting insects, and there is no sufficient reason for supposing that it has ever been concerned in the collection of pollen. The question of the cauline or foliar nature of the Gnetalean ovule arises in this connection; this is discussed in detail, and it is shown that recent investigations tend to confirm the opinion that it is cauline. Finally, the new knowledge furnished by MM. Lignier and Tison for Gnetum is summarised, and their comparisons of the Gnetalean and Angiosperm flowers are reduced to tabular form and correlated with those of other investigators, figures being given to render the comparison and correlation clear.—P. A. v. d. **Bijl**: Heart rot of *Ptaeroxylon utile* (sneezewood) caused by *Fomes rimosus*, Berk.

BOOKS RECEIVED.

The Bearings of Modern Psychology on Educational Theory and Practice. By C. M. Meredith. Pp. 140. (London: Constable and Co., Ltd.) 1*s*. 6*d*. net.

Color and its Applications. By M. Luckiesh. Pp. xii+357. (London: Constable and Co., Ltd.) 16*s*. net.

An Introduction to the Use of Generalized Coordinates in Mechanics and Physics. By Prof. Byerly. Pp. vii+118. (London: Ginn and Co.) 5*s*. 6*d*.

Organic Agricultural Chemistry. By Prof. J. S. Chamberlain. Pp. xvii+319. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 7*s*. net.

Practical Mathematics for Technical Students. By T. S. Usherwood and C. J. A. Trimble. Part ii. Pp. x+565. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*.

Historical Synopsis of the Royal Cornwall Polytechnic Society for the Years 1833–1913. By W. L. Fox. Pp. 80. (Falmouth: J. H. Lake and Co.)

Journal of the Institute of Metals. Vol. xv. No. 1. Pp. viii+392. (London: The Institute of Metals.) 21*s*. net.

The Investigation of Rivers. Final Report. Special. (London: Royal Geographical Society.) 3*s*. 6*d*. net.

Preservatives and other Chemicals in Foods: Their Use and Abuse. By Prof. O. Folin. Pp. 60. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.) 2*s*. 6*d*. net.

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THURSDAY, AUGUST 24, 1916.

COAL-TAR AND AMMONIA.

'oal-Tar and Ammonia. By Prof. G. Lunge. Fifth and enlarged edition. Part i. *Coal-Tar.* Pp. xxix + 527. Part ii. *Coal-Tar.* Pp. xi + 531 to 1037. Part iii. *Ammonia.* Pp. xvi + 1041 to 1658. (London: Gurney and Jackson, 1916.) Price, three parts, 3*l.* 3*s.* net.

THIS well-known book is one of the acknowledged classics of chemical technology.)riginally published in 1882, it has now reached ts fifth edition. Perhaps nothing could posibly serve to illustrate more strikingly the xtraordinary development of chemical industry luring the past third of a century than a comarison of the contents and size of the volumes f the successive editions. The 1882 edition, hich all authorities agreed was a faithful reflecion of the then condition of this particular ndustry, consisted of a modest volume of some 70 pages, of which about 300 treated of oal-tar, its origin, properties, distillation, actionation, etc., while fewer than sixty pages ere devoted to the subject of ammoniacal quor, its treatment, and the manufacture of the ore industrially important ammoniacal salts, the emainder of the book comprising tabular matter, onversion tables, appendix, and index.

The present (1916) edition extends to three olumes, each of which is nearly double the size the single volume of which the first edition onsisted. Two of these volumes are taken up ith coal-tar and its products, while the third eats exclusively of ammonia and its commeral compounds. It may serve to indicate the portance which this subject has assumed to ate that the space which has now to be given it is nine times greater than was needed some irty-four years ago.

In the first edition no attempt was made to timate the amount of the by-products obtained the destructive distillation of coal. In the rly 'eighties the industry, although no longer its infancy, was still comparatively unveloped, and statistics were not readily aville, nor when obtained were they very contetent. Wurtz, in 1876, in connection with the rly history of the coal-tar colouring matters, d estimated the total production of coal-tar in irope at about 175,000 tons, of which Great itain produced about 130,000 tons. Weyl, of annheim, some years later, put the amount for Europe at 350,000 tons, of which England oduced more than half, exclusively, of course, m gas-works. In 1880 Germany worked up y 37,500 tons. In 1883 the total production the principal European countries was stated Gallois to be 675,000 tons, of which Great tain produced 450,000 tons and Germany 000 tons. At about that time (1884), accord- to a report of the directors of the South Metropolitan Gas Company, the sale of tar and sulphate of ammonia realised 82 per cent. of the initial cost of the coal incidentally employed. "Residuals," however, do not always command such prices. Tar, for example, has fluctuated in value in recent years from 26*s.* a ton in 1903 to as low as 11*s.* in 1909. Owing to the special circumstances of the times it has doubtless greatly increased in price.

The production of tar and the working up and treatment of tar-products and "residuals" generally have made enormous strides in Germany during recent years, and she is now, in all probability, no longer dependent upon outside sources as she formerly was. Very recent statistics are, of course, not to be looked for. The latest which are available for a comparison between our position and that of Germany in this respect refer to 1909, and no doubt are not strictly applicable to the present abnormal conditions. But even as they stand they are very significant, and leave no room for doubt as to their meaning.

According to the figures furnished by the author the amount of tar produced in the United Kingdom in 1909 was 1,100,000 tons, made up as follows:—

	Tons
Gas-tar	750,000
Coke-oven tar	150,000
Blast-furnace tar	200,000
	1,100,000

In the same year the aggregate production of tar from all sources in Germany was 1,012,000 tons. In other words, whilst the United Kingdom had rather more than doubled her production in about twenty-five years, Germany, during the same interval of time, had increased her supply by about twelve times the amount. There can be little doubt that her production at the present time exceeds that of the United Kingdom and that we have now definitely lost our preeminence in this particular industry. The greatly increased production in Germany would appear to be due to the extraordinary development of the coke-oven industry which has taken place within recent years in that country. There is at the present time about three times as much coke-oven tar produced in Germany as of gas-tar, whereas with us the amount of coke-oven tar until quite recently was barely half that of the gas-tar. This great disparity in the rate of development of this particular phase of the industry is, no doubt, due to several causes, some of them, possibly, purely economic. On the other hand, something must be set down to the conservatism and apathy of coalowners and to the prejudice of ironmasters. It is lamentable to think how one of the greatest assets this country possesses continues to be wasted through ignorance and neglect. Some day we shall wake up to the fact that we have heedlessly squandered the potential riches with which we have been endowed.

Considering the part played by coal-tar

products in furnishing certain of the raw materials needed in the manufacture of high explosives, the astonishing development of the coal-tar industry in Germany affords one more illustration of the means by which that country has so sedulously prepared herself for the titanic struggle upon which she has embarked.

It remains to be seen what the influence of the war will be on the future of tar production and distilling in this country. It is practically certain that Germany will no longer be the market for our intermediate tar-products that she has hitherto been. Dr. Lunge tells us, what we begin to realise, that Germany "is now in a position to furnish almost the whole of the requirements of coal-tar products for its colour industry, the largest in the world." What is in store for the colour industry with us is very difficult to forecast. Time and a more intelligent fiscal policy may tell. As we all know, attempts are being made to recover the great leeway we have lost by our lack of foresight and our want of an intelligent appreciation of the relation of science and research to industry. It is to be hoped, in the interest of our textile manufactures, that at least a certain measure of success may be reached. But it is questionable whether, on the lines of the present effort, the success will be very far-reaching. It is certain that the methods which are being employed are very different in character from those which have placed the industry in its present high position in Germany. It is no less certain that no other mode of direction than this last will be successful in the long run.

As compared with the preceding edition, which appeared in 1909, the most important factor of increase in the present work is in the section relating to ammonia, concerning which there has been a great development within recent years. Ammonia and ammoniacal compounds are, of course, used to a large and increasing extent in a great variety of industries, *e.g.* manufacture of alkali; coal-tar colours; in bleaching, dyeing, and calico-printing; in zinc-coating; explosives; artificial silk; medicine, pharmacy, and photography; and in the production of cold. But by far the largest amount of combined ammonia is used in agriculture. During the first decade of this century the consumption of ammonium sulphate rose from 125,000 to 322,000 tons, whereas during the same period the consumption of sodium nitrate rose from 470,000 to 637,000 tons—a far less rapid rate of increase than in the case of the ammoniacal salts, which is bound to get still less as the Chile beds approach exhaustion. Although synthetic methods of production of ammonia will play an increasingly important part, it is practically certain that the principal source of ammonia and its compounds will continue to be the nitrogen of coal, and it is on the development of the coking industry and on the recovery of the by-products formerly lost that the future of the ammonia industry will depend.

We heartily congratulate the veteran Professor Emeritus of the Zurich Federal Techni[...] University on the appearance of this admira[...] work. Dr. Lunge deserves well of the indus[...] which he has laboured so faithfully to ser[...] Every page of his treatise bears witness to [...] zeal and painstaking care with which it has b[...] compiled and revised. The book, as hitherto, admirably printed and excellently illustrat[...] Indeed, no efforts have been spared by all c[...] cerned to make it, what it unquestionably is, far the most complete and authoritative work have upon the important subjects of which treats.

T. E. THORPE.

MATERIALS OF CONSTRUCTION.

The Structure and Properties of the More Co[...] mon Materials of Construction. By G. [...] Upton. Pp. v+327. (New York: J. Wi[...] and Sons, Inc.; London: Chapman and H[...] Ltd., 1916.) Price 10*s*. 6*d*. net.

THIS volume had its origin in a course [...] theoretical instruction preparatory to [...] laboratory course at Sibley College, Corn[...] University. The first part deals with the elas[...] theory and the determination of the properties [...] materials of construction, chiefly metals, by te[...] ing. The ordinary rules connecting stress a[...] strain are discussed, but not in general the [...] struments used in testing. Rather more att[...] tion is given to the behaviour of materi[...] strained beyond the elastic limit than in treati[...] on applied mechanics. Some of the stateme[...] are rather too dogmatic. Is the author sure t[...] in a tension test "the break must start at [...] outside and work inwards" (p. 36)? Engl[...] engineers will scarcely agree with the statem[...] that "there is not much excuse for the use of [...] Rankine or Ritter formulas" for columns. It [...] be new to them to learn that "live loads appl[...] without shock (for example, a rolling load cro[...] ing a bridge at low speed) actually set up stres[...] twice as great as a dead load of the sa[...] amount." The injurious effect of a live l[...] without shock as compared with a dead load [...] not that it increases the stresses, but tha[...] causes the "fatigue" effect. Of course, also [...] produces shocks, which the author deals w[...] separately. A live load is not a suddenly app[...] load. Nevertheless, this section is generally c[...] and useful. The discussion of the cause of fati[...] failure is fuller than usual. No attempt is m[...] to give collections of results of tests.

The second and rather larger part of the b[...] deals with the internal structure of materials [...] its modification by mechanical action, heat tr[...] ment, etc. Is it true that the corrosion of [...] "takes place whenever the moisture in con[...] with the metal becomes electrolytic either by a[...] or *alkalies*"? Freezing-point and equilib[...] diagrams for lead-tin and iron-carbon alloys a[...] described, and the constituents of cast-iron [...] steel, austenite, pearlite, ferrite, cementite, [...] are discussed very fully. So also are the vari[...]

f the properties of steel with the carbon content nd the influence of nickel, manganese, vanadium, hromium, etc. The author gives a general theory f the heat treatment of steels which is original, nd which, the author believes, throws much light n practical problems and is certainly interest- ng. Cements are shortly treated in a final hapter.

Although some defects, probably due to haste, ave been indicated, this treatise is really a good ne and can be recommended to practical engi- eers as containing information not easily acces- ible elsewhere. Perhaps the fault of being rather o positive in accepting conclusions not fully stablished is one to which a teacher of students , specially liable.

SOUND ANALYSIS.

he Science of Musical Sounds. By Prof. D. C. Miller. Pp. viii + 286. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1916.) Price 10s. 6d. net.

UNDER the above title the author has presented in book form a series of eight ctures on sound analysis delivered at the Lowell nstitute in January and February, 1914. A ourse of scientific lectures designed for the eneral public must consist in large part of ementary and well-known material, selected and ranged to develop the principal line of thought. ut it is expected that lectures under the auspices the Lowell Institute, however elementary their undation, will present the most recent progress the science in question. It is further expected at such lectures will be accompanied by experi- ents and illustrations to the greatest possible gree.

Thus, in the present work, we find that mathe- atical treatment is almost absent; the few equa- ns that occur throughout its pages might be llected so as to appear at a single opening of e book. On the other hand, the figures number arly two hundred, many of them being photo- aphic reproductions of vibration curves or paratus. These serve to indicate the wealth of e demonstrative material by which the lectures re illustrated.

The first lecture deals with sound-waves, simple rmonic motion, noise, and tone; the second with characteristics of tones. The third lecture is ncerned with methods of recording and photo- aphing sound-waves, and includes a description the author's special recorder called the *phono- k.* Lectures four and five develop the analysis d synthesis of compound harmonic curves, and at the influence of horn and diaphragm. The th and seventh lectures are concerned with the e qualities of musical instruments and the sical characteristics of the vowels. The eighth ture treats the problems of the synthesis of vels and words, and concludes with remarks on relations of the art and science of music.

The work includes a valuable bibliographic appendix of more than a hundred references. The type and illustrations are large and clear, and the book should prove welcome to a wide circle of readers and find an honoured place in every acoustical library.

E. H. B.

OUR BOOKSHELF.

Studies in Blood-Pressure, Physiological and Clinical. By Dr. George Oliver. Edited by Dr. W. D. Halliburton. Pp. xxiii + 240. Third edition. (London: H. K. Lewis and Co., Ltd., 1916.) Price 7s. 6d. net.

THIS posthumous edition opens with an obituary notice of the author by Prof. Halliburton, who has undertaken the duties of editor as a "true labour of affection and respect." This latest edition embodies the chief advances in the clinical investigation of blood-pressure, and contains a description of the author's own instruments for testing the pressure. It is argued that the condition of the vessel wall does not seriously interfere with correct readings; hypertonicity, which produces the greatest resistance, can be counteracted by repeated compression or massage. It is noteworthy that occupations involving anxiety, worry, and nerve strain tend to augment blood-pressure. It is pointed out that "pulse-pressure" (the difference between the systolic and the diastolic pressure) tends to increase after the age of forty. The suggestion that arterio-sclerosis may be so advanced as to cause an entire abolition of vasomotor control is open to question; for it is difficult to see how life could be carried on under such conditions. The author holds that widespread thickening of the arterial wall suffices to maintain long-continued high pressure, and that there is no need to postulate persistent hypertonicity of the arteries, which he considers physiologically improbable.

The Chemistry of the Garden: A Primer for Amateurs and Young Gardeners. By Herbert H. Cousins. Revised edition. Pp. xviii + 143. (London: Macmillan and Co., Ltd., 1916.) Price 1s.

WHEN the demand for a book is such that it needs to be reprinted eight times since its first issue in 1898 and now calls for a revised edition, it obviously needs little commendation to the public for whom it is written. Mr. Cousins's volume contains in its 143 pages a vast amount of information on the management of soil for the successful production of garden crops. In the new edition we notice reference to recent Rothamsted work on partial sterilisation and to the shortage of potash caused by the war. On the latter account the gardener need not worry, as any moderately good garden soil has ample reserves of potash, which can be made available as plant food by suitable treatment. We do not agree with two of the author's remarks on dung. He says that "no analysis is of much value": on the contrary, experience at Rothamsted and elsewhere shows that

the crop yields consistently follow the chief analytical figures, and especially the ammonia. Again, stable (horse) manure is said to be more liable to loss on keeping than cow manure. Recent experiments show that horse manure loses much less nitrogen than cow manure during storage for periods of three or four months. The chapter on garden remedies and insecticides is likely to be very useful this summer, when pests of all kinds are unusually active. E. H. R.

The World and its Discovery. By H. B. Wetherill. Part i., *Africa*, pp. 119. Part ii., *Asia*, pp. 99. Part iii., *America*, pp. 131. Part iv., *Australia*, pp. 62. (Oxford: At the Clarendon Press.) Price 1*s*. each.

MR. WETHERILL has a story of surpassing interest to tell, and he succeeds in conveying, by means of the accounts of the work of the chief explorers, a succinct summary of the main features of the geography of the four continents other than Europe. Told in this fashion, with the emphasis on the lands and their peoples, the geography of the remoter continents becomes vivid, and thus appeals to the pupils with a sense of reality; experience with this book leads to these conclusions. For example, the characteristics of the people and the lands near the Gambia and the Niger gain in precision and definiteness in relation to the travels of Mungo Park; and the gradual development of the story of the conquest of the Central Australian desert provides a useful account of the control exerted upon life on the earth by the absence of rain in a hot region.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Formation of Dust-ripples.

LAST evening when returning from a visit to the trenches I noticed an interesting illustration of the formation of dust-ripples. A battery of field-guns had been placed nearly parallel to a road some 2000 yards behind the lines. Owing to the continued fine weather the roadway was covered by a coating of fine dust. The guns were about 100 yards from the road, on lower ground, and pointing so that the shells just cleared. The battery had been in action all day. There was very little wind and no traffic over the road during day-time. The whole surface of the road in front of the guns was covered by a series of small ripples at right angles to the direction of the guns. The ripples were about 1/12 in. apart, from east to west. They were evidently caused by the explosive wave passing over the road. The same effect can be produced by discharging a Leyden jar across a spark-gap near a card on which some light powder has been sprinkled, or by tapping sharply a piece of parchment stretched tightly over the end of a lamp-glass containing fine powder. H. U. G. (C.F.).

France, August 10.

A Sunset Phenomenon on July 22.

REFERRING to the sunset phenomenon seen July 22, and described in NATURE of July 27, it se probable from information kindly sent by var correspondents that the clouds seen were somewh in the neighbourhood of Plinlimmon. If this the case, the height of the tops of the clouds w have been from 18,000 to 18,500 ft., and the clouds would have been about eight miles apart. correspondent who watched the sunset from Minc hampton Common reports that no clouds were vi from there, but even from so far west the alti of clouds at a height of 18,000 ft. over Plinlim would not have exceeded 1° 40′, and they w have only been visible if the horizon were a good and the atmosphere very clear. In asking for infor tion from Ireland I was casting my line too far; the of a cloud the height of which is 24,000 ft. (whic probably high for a cumulo-nimbus in these latitu would not be visible more than 190 miles away. distance of Plinlimmon from Farnborough is miles; clouds at such distances can probably onl seen when the sun sets behind them in an other clear sky. C. J. P. CAV

Meteorological Office, South Farnborough, August 14.

The Utilisation of Waste Heat for Agriculture.

WITH regard to Mr. Carus-Wilson's fear (NAT July 27) that the heating of the earth will mul pests, one may point out that earth-warming is alr greatly used. Large areas of land are covered glass to maintain a high temperature, and land is heated directly for forcing rhubarb. One may clude that farmers would welcome further means heating the land if the expense were not too grea

If the waste heat from electricity stations were in the manner I have suggested, it would stil possible to remove the heat during winter month destroy pests, if this were found desirable, or could even cool the ground artificially.

I would like to mention here Prince Kropotl astonishing book, "Fields, Factories, and Worksho in which he shows that agriculture may be spe up in a way that would surprise most people look on farming as an almost non-progressive in try. In it the author states that even in France, its abundant sunshine, growers are experimen with the direct heating of the soil, and if found advantage there, surely it would be even more s this country. C. TURNBU

Electricity Works, Tynemouth, August 4.

A Peculiar Thunderclap.

THE writer would suggest as an alternative exp tion of the peculiar thunderclap described by Mr. (NATURE, August 17) at different places within circumscribed area he mentions that probably lightning discharges were not from cloud to earth in the reverse direction, from a large area of gr heavily charged relieving itself at several points s taneously. H. O.

ENGINEERING EDUCATION AND SEARCH IN RELATION TO ORGANISATION OF BRITISH GINEERING INDUSTRY.

THE Manchester Engineers' Club, which established about three years ago, inc among its members most of the leading engi in South-East Lancashire. During the winter of the war a series of debates was he

the club on problems connected with the future of British engineering. About Easter, 1915, a committee was appointed to bring together some of the suggestions which had most commended themselves to the club in the course of these debates. The committee met weekly during the summer of 1915, and in November last presented its report to the club. This report was unanimously adopted.

A number of members of the club then formed themselves into a "Council for Organising British Engineering Industry," and proceeded at once to secure the support of engineering firms in the neighbourhood of Manchester. At the present time, almost every important engineering concern in the Manchester district, and all but very few throughout South-East Lancashire, have promised their support to the movement. Moreover, the professional societies which have been approached by the Council have replied sympathetically, and have, for the most part, promised their active co-operation.

The time has come for the extension of the movement so as to make it of national dimensions. Steps have already been taken to extend its activities to the Midlands, where influential support is assured. Meanwhile, the British Engineers' Association has been moving in a similar direction. The fusion of the two movements appears to be imminent. When that fusion has taken place, the process of organising British engineering industry should proceed more rapidly still.

The report which led to the establishment of the Council for Organising British Engineering Industry began by pointing out that the development of British engineering export trade had been highly unsatisfactory for some years, while Germany had been making rapid progress. The report suggested that Germany's success had been due "to education, to co-operation, and to organisation in manufacturing and selling, backed up by adequate financial support; in Britain, on the other hand, education" had been "unsystematic, organisation weak, and co-operation between competing firms almost non-existent." The committee concluded that every British engineer ought now to realise that his British competitor in some markets must be his friend and ally in others; and that, in short, the time had come for the federation of British manufacturing engineers so as to organise the industry. The report proceeded to describe in outline the association of manufacturing engineers which the committee would like to see formed. The co-ordination and development of education and research were given prominent places among the functions of the proposed association.

Since the adoption of the report and the establishment of the Council, the question of engineering education and research has continued to receive attention. In evidence given on behalf of the Council to the Board of Trade Committee on the Iron, Steel, and Engineering Trades, special emphasis was laid upon the Council's view that, without the co-operation of engineering manufacturers in the education of engineers and without a great increase in the volume of engineering research, no amount of organisation could place the British engineering industry on a permanently satisfactory basis. The Board of Trade asked for further particulars of the Council's proposals in regard to education and research. The Council accordingly appointed a committee to report further upon this matter. The following is a summary of the committee's recommendations, which have been approved by the Council and forwarded to the Board of Trade:—

1. The organisation of British engineering industry, by the federation of British manufacturing engineers, for purposes which include education and research. Such a federation should co-operate with governing bodies of schools and colleges, as well as with education authorities, in providing a satisfactory system for educating engineers; with universities and colleges in testing and research; and with the Government in conducting a central research institution specially equipped for investigations with which existing research laboratories are unable to cope.

2. The co-ordination of the existing means for educating engineers and, in particular, the provision of an adequate and more uniform system of scholarships. To this end, the number of local education authorities for the highest education should be much reduced, correspondingly larger areas being assigned to each.

[This recommendation was supported by an appendix showing the number and value of the university scholarships at present offered by various local education authorities. It appeared from these figures that a candidate's chance of winning such a scholarship largely depends upon the particular town in which he happens to live.]

3. That a large number of "junior technical schools" be established for the education between twelve and fifteen of boys who intend to become apprenticed to engineering trades.

4. That all apprentices under eighteen years of age be required to attend part-time classes for, say, eight hours a week during works hours; but that this be subject to certain exceptions in the case of young people who continued in attendance at secondary or junior technical schools up to at least fifteen years of age.

5. That the instruction given to trade apprentices in these part-time classes be reformed so as to relate it more closely to the apprentices' everyday work and so as to include what are known as citizenship subjects—for example, economic history; and that, where a sufficient number of apprentices is employed by the same firm, such classes be conducted in that firm's own works and by the works staff.

6. That the specific education given to future members of the highly trained staff be provided in a university or college of university rank for the majority, who should be enabled to continue their studies up to twenty-one or twenty-two years of age; and in a "senior technical school" for the minority, who may have to enter engineering works at eighteen.

7. That boys who are to study engineering in a university should carry their study of mathematics and physical science to a higher stage before leaving school, and that, in general, the education of a boy at school, instead of being entrusted (as in some modern secondary schools) to six or seven specialist teachers whose business it is to advance his know-

ledge of an equal number of separate subjects to a uniform level of mediocrity, should be in the hands of a succession of form masters, who, knowing their boys well, may exercise a profound influence upon their characters and carry to a high level their studies in a more coherent curriculum.

8. That the conditions for admission to universities should be reconsidered and rendered more uniform as between different universities and less uniform as between different faculties and different honours schools in the same university; and that, in the interest of candidates of mature age and of other candidates approaching the university otherwise than through the normal avenue of the secondary school, university entrance tests should be distinguished from secondary school examinations.

9. The reform of university teaching in certain important respects, notably by a reduction in the number of lectures.

10. That the completion of a three years' university course in engineering should entitle students to no more than the B.A. degree; and that, until candidates have added works experience to academic training, they should not receive technical degrees (such as Bachelor of Engineering or Bachelor of Technical Science) which might then serve as professional qualifications.

11. That any time spent in works between school and college should not be unduly prolonged.

12. That university teachers be encouraged to undertake research on behalf of, and in co-operation with, manufacturing firms; and that additional Government grants be paid to universities and colleges with this end in view.

13. That, by the establishment of such an association of manufacturing engineers as we have advocated and by other means, the volume of research work carried out in connection with the British engineering industry be greatly increased; and that provision be made for this increase in the volume of research by fully utilising and extending the facilities already available in universities and colleges, as well as in the works of private firms, and also by establishing a central research laboratory for investigations that cannot be undertaken elsewhere.

The report was accompanied by a diagram illustrating the scholarship system recommended by the committee. This diagram differs but slightly from one reproduced in NATURE of October 21, 1915 (vol. xcvi., p. 214).

J. C. M. G.

THE OPTICAL INDUSTRY IN FRANCE.

A SERIES of articles by various authors has recently been appearing in the *Revue générale des Sciences* on the methods to be adopted for the development of French trade after the war. Amongst these have appeared two articles (May 30 and June 13) by M. A. Boutaric on the French optical industry and its future.

He points out that before the Napoleonic wars France had been dependent on England for its optical glass, and it was as a result of the British blockade that its manufacture was commenced in France.

At the present time the house of Parra-Mantois manufactures practically all the special optical glasses made by Schott and Co., and the French makers undoubtedly are more successful tha their competitors in the manufacture of the glas discs required for very large astronomical mirro and objectives. In every branch of optic science French physicists have invented instru ments and methods for testing their qualities, bu the French manufacturers have not done them selves justice by an efficient catalogue propa ganda. M. Boutaric, when referring to the fir of Zeiss, mentions especially that it "has su rounded its products with a scientific propaganda. He shows how severe the German competition i microscopes was before the war, although the are two good French makers—Nachet an Stiassnie. The metallurgical microscope of L Chatelier has been developed by Pellin with co siderable success. The polarimeter in its prese commercial form was developed by the Frenc makers Soliel and Laurent, and is essentially French instrument, yet the German houses ha almost obtained a monopoly in the sale of th instrument outside France.

The manufacture of binoculars is the most su cessful of all the French optical industries, sever large firms (Balbreck, Baille-Lemaire, Socié française d'Optique, Société des Lunetiers, etc being employed in their manufacture. As showin the large quantity of optical glass used in the glasses, it is stated that the Société des Lunetie alone use about 200,000 kilos of glass annually.

Although French makers showed several pris binoculars of the Porro type at the 1867 Exhibitio yet the manufacture of these glasses passed almo entirely to Germany. Now, however, glass equal to the best German models are being mad in France in large numbers for her Army an those of her Allies. The original supremacy the French photographic lens has passed awa because, in the opinion of M. Boutaric, the Frenc makers did not use the new glasses and moder grinding methods, nor sufficiently avail themselv of skilled technical knowledge. M. J. Richard ha developed with great skill and success a stere scopic camera, the "Verascope," and also a ver rapid camera shutter, but the majority of th cameras used in France have been imported. Th kinematograph, the invention of a Frenchma Prof. Marey, has been carried to a high state perfection by the firms of Lemaire, Pathé, an Gaumont. To a certain extent France is depe dent on outside sources for kinematograph film but, on the other hand, she exports finished print film to the annual value of 600,000*l*. The ligh house industry, built on the theoretical work Fresnel, is a successful one, although it has ha to face keen competition from English and Germa makers.

M. Boutaric points out that although in near all optical matters French savants are the pioneer yet the French optical industry is very small compared with the German. In an interestin paragraph he endeavours to analyse the reaso for this success. "Here, as in everything else, t Germans have been saved by their deep sense business. The German industry demonstrates

a wise publicity the worth of its goods, sometimes excellent, but sometimes also copies of our models and inferior to ours; their catalogues, well edited and illustrated, are published in many languages, and give full details of the instruments they describe, their travellers, men of parts, knowing intimately their instruments . . . and trying to satisfy the wishes of their customers."

M. Boutaric points out that the collaboration between the man of science and the manufacturer is far more close in Germany than in France. In the former the man of science is in intimate touch with the works, and is well paid for his services. The foreman and apprentices are trained in the theoretical side of their subject in classes they are obliged to attend. In the firm of Zeiss half the time spent by the workers in the technical classes is counted as time spent in the works. No steps are neglected to perfect the organisation as a whole; everything is done to make the machine independent of a single individual. In France the success and reputation of a firm have too frequently depended on one individual. That some steps are being taken to strengthen the optical industry in France is shown by the fact that a large factory has been built by La Société française d'Optique, formed in conjunction with the firm of Lacour-Berthiot, for meeting the competition of the best German firms. M. Boutaric urges that if the future of the industry is to be assured, new blood must be introduced, young mechanics trained, and a school of optics founded. This school, for which M. Violle has pleaded, should be divided into at least two sections: optics proper and photography. In it practical classes on glass grinding, etc., should be given in conjunction with theoretical work.

After an appeal for mutual co-operation between the various firms and individuals interested, M. Boutaric urges that the Government should take steps to protect French patents and trade marks against unfair competition. Anyone with experience of the laxity of the French patent specification and patent laws will appreciate the force of this appeal.

ARCTIC OCEANOGRAPHY.

IMPORTANT contributions to Arctic oceanography are contained in the report of Dr. F. Nansen's work in Spitsbergen seas in 1912 ("Spitsbergen Waters." By F. Nansen. Christiania, 1915). Dr. Nansen spent July and August of that year in his yacht, the *Veslemöy*, on the west and north of Spitsbergen. His main object was to push far to the north to get deep-water samples from the polar basin in order to make more accurate determinations of specific gravity than were possible during the voyage of the *Fram*. But this aspect of the expedition was only partially successful on account of the pack ice being unusually far south. However, a great deal of valuable work was done, both in the open seas and in the fjords. Only one or two of many interesting results can be noticed here.

It has been maintained that the melting of glacier ice has a considerable cooling effect on the water strata of Spitsbergen fjords. Dr. Nansen confutes this idea. He took a vertical series of temperatures at the entrance to Ice Fjord in July, when it was clear of ice, and again in August, when ice almost blocked the way. The water at 50 metres and the intermediate cold layer were much warmer in August than in July. Again, in Cross Bay, at both 100 and 200 metres from the face of Lillehook Glacier, the cold intermediate layer was both thinner and warmer than further out in the fjord. The bottom temperatures near the glacier were also higher than further out in the fjord. But as the surface salinity was greater near the glacier than further away it would appear that the glacier ice does not melt rapidly at the upper end of the fjord. The high salinities of the inner end of the fjord may be in part due to the more extensive formation of ice in winter there than further out, which would increase the salinity.

Another important matter raised in this paper is the extension and shape of the north polar basin. In this matter Dr. Nansen has modified his views since the days of his *Fram* expedition. The result of that expedition led to the belief that the water of the north polar basin differed from that of the Norwegian Sea. The work of the *Veslemöy* contradicts this, and shows that the salinities of the two are identical. The deep water of the north polar basin is probably derived from the Norwegian Sea. This discovery does away with the necessity for postulating a high submarine ridge between Greenland and Spitsbergen, yet one at a depth of about 1200–1500 metres is still necessary to account for the difference in temperature of the deep water in the two basins. In any case, if the deep water of the polar basin is derived from the Norwegian Sea and not formed in the basin itself, there is no need to believe in such an extensive polar basin as formerly was considered necessary. The discovery, a few years ago, by Vilkitski, of islands north of Cape Chelyuskin does something to confirm this belief in a less extensive deep basin. It is true that the Stefansson expedition found no new land, and that Peary's Crocker Land has apparently no existence, but these facts do not disprove the possibility of a wide continental shelf, and Nansen goes at considerable length into questions of the drift of the *Fram* and of the ice to substantiate the probability of this being the case. We have followed Nansen in using the form Norwegian Sea, but there seems to be no reason why this should replace the older and generally accepted name, Greenland Sea.

NOTES.

DR. J. O. BACKLUND, M. B. Baillaud, Sir F. W. Dyson, Dr. P. Lowell, Prof. F. Schlesinger, and Prof. H. H. Turner have been elected honorary fellows of the Royal Astronomical Society of Canada.

THE provisions of the "Summer Time" Act will cease to operate at the end of September. In a

written answer to an inquiry raised by a member of Parliament the Home Secretary said:—"The three hours following midnight (Summer Time) of the night of September 30–October 1 are included in the Summer Time period. The change does not take place until 3 a.m. Summer Time, or 2 a.m. Greenwich Time, on October 1. At that hour the clocks will be put back one hour, so that the period 2–3 a.m. Summer Time will be followed by a period 2–3 a.m. Greenwich Time, and they can readily be distinguished by the addition of the words 'Summer Time' or 'Greenwich Time,' as the case may be."

WE announce with much regret the death, on August 20, at the age of fifty years, of Dr. T. Gregor Brodie, professor of physiology in the University of Toronto.

THE *Times* for August 11 contains a notice of the death in action of a very promising young geologist, Eric Warr Simmons, who was gazetted 2nd Lieut. in the 6th York and Lanc. Regiment in January, 1915. He took part in the landing at Suvla Bay, and was reported missing on August 11, 1915. He studied geology at University College, London, gaining several prizes and a university scholarship, and graduated with first class honours in 1914. He was a student-demonstrator in the geological department of University College. He was an enthusiastic member of the University O.T.C., and immediately after taking his degree applied for, and obtained, a commission. He had no time, therefore, for completing any original research. He was elected a fellow of the Geological Society in 1915. His death adds another name to the list of the younger generation of scientific men from whom much was expected who have perished in the war.

THE death is announced, in his sixty-fourth year, of Mr. C. W. H. Kirchhoff, one of the leading American authorities on metallurgy and allied subjects. A native of San Francisco, he graduated at the Royal School of Mines, Clausthal, Germany, in 1874, as mining engineer and metallurgist. Returning to America, he served for three years as chemist of a lead refinery in Philadelphia, and then joined the staff of the *Metallurgical Review*. His principal work in technical journalism was done in connection with the *Iron Age*, of which he was associate editor from 1884 to 1889 and editor-in-chief from 1889 to 1910. From 1883 to 1906 he was a special agent of the U.S. Geological Survey for the collection of statistics on the production of lead, copper, and zinc. He was elected president of the American Institute of Mining Engineers in 1898 and again in 1912. In 1910 he published "Notes on Some European Iron Districts."

THE sixty-first annual exhibition of the Royal Photographic Society opened last Monday at the Suffolk Street Galleries, and it is surprising to see how little effect the war has had upon the number and the interest of the exhibits. The chief, if not the only reminder of the crisis is a series of three official war photographs, panoramas made by the Printing Company of the Royal Engineers. They are enlargements of two diameters from 5×4 negatives, taken with telephotographic lenses (30 in. and 72 in. equivalent focal lengths) on panchromatic plates and with dense colour screens. They show the trenches. Each consists of several prints joined to form a continuous picture, and the quality of the work leaves, practically speaking, nothing to be desired. Among the photomicrographs is a fine series of sixty by Mr. G. Ardaseer of the Radulæ of Mollusca from specimens lent by the Rev. Prof. H. M. Gwatkin, Mr. E. A. Pinchin sends a series of Naviculæ, photographs of diatoms of a quality that has never been surpassed and rarely equalled, and Dr. G. H. Rodman's macroscopic and microscopic examples of the flora and fauna remains found in Coal Measures, from specimens in the Natural History Museum, form an extensive and very valuable series. Among the astronomical photographs, the most remarkable are by Dr. R. W. Wood of Saturn and Jupiter taken at Mount Wilson by the 60-in. reflector. Each planet is photographed by means of infra-red, yellow, violet, and ultra-violet light, and the differences are demonstrated by various combinations of these in different colours. Of the many other exhibits we have only space to refer to Mr. J. H. Gardiner's auto-radiographs of radium-bearing minerals, which clearly show the radium-bearing parts of each specimen, and Miss M. O. Edis's photographs of Sir James Dewar's 17-in. soap bubble taken during the first, second, and third weeks of its life, the last quite black and very near to the limit of thinness.

AN increased prevalence of acute poliomyelitis (infectious or infantile paralysis) is reported in New York and in Aberdeen. The somewhat alarmist notices on the subject in the daily Press are scarcely warranted at present, as the actual number of cases notified does not appear to be large in either case—forty-eight in the former and thirty-nine in the latter. But the disease is most prevalent in July, August, and September, so that the occurrence of further cases is likely. As regards the British Isles, the population in general and adults in particular, seem to be relatively insusceptible. The early recognition and isolation of the first cases are important, for all the available evidence points to the transmission of the disease by direct contact with acute cases or carriers, and not by flies or vermin. The secretion from the nose or mouth nearly always seems to be the source of infection. The virus is easily destroyed by dilute solutions of disinfectants and does not appear to be capable of survival for more than a very short period outside the human body.

THE American Museum has recently selected from its large collections a special exhibit of moccasins illustrating the principal patterns and their decoration, as well as the relation between the style of decoration and the structure. The true moccasin is almost confined to Canada and the northern two-thirds of the United States. So far as the data from the museum collections, described by Mr. C. Wissler in the *American Museum Journal* for May, indicate, it does not occur in Mexico or South America, but it extends to Siberia and Lapland. Though the types used by American Indians seem to be infinitely varied, they possess a few common structural features. As regards material, reindeer skin is used in the Old World and caribou in the New, two closely allied species. It thus turns out that the skin shoe is the correlate of the reindeer culture, a fact of interest to the ethnographer. As regards decoration, the styles were at the outset correlates of the structural pattern, serving at first some useful purpose; but when once they were established as styles they were carried over to footwear of other kinds where they serve no practical purpose.

THE designer of art fabrics, who is always in search of new sources of inspiration, may well direct his attention to the article on the decorative value of Indian art, by Miss E. A. Coster, in the May issue of the *American Museum Journal*. The patterns in Indian weaving have not the variety shown in Persian and Italian textiles, but possess strength, simplicity and fine proportion. For the worker in ceramics there are unbounded possibilities, both in shapes and decorations. In metal-working the rosette type of decoration will be especially helpful. The author rightly

observes :—"In adapting Indian motives the primitive spirit must be retained or the result will be a disappointment; but a reversion to the simplicity and free expression of Indian art is what modern craftsmen most need to counteract the tendency to over-decoration, mechanical technique, and lack of individuality."

THE question of the origin of the dolmen is a subject of active controversy into which we have at present no desire to enter. But for the benefit of those who are interested in the problem we may note the latest theory presented by Mr. Harold Peake in the August issue of *Man*. He suggests that prior to 2200 B.C. some traders from the north of the Ægean, familiar with the use of copper, and probably possessing the secret of bronze-making, set out from their home, which may have been Lemnos, in search of copper and tin. He notes in this connection the cult of the Dactyls or Cabiri, mysterious divine or heroic beings, at some centre in the south-east Ægean, and of Hephaistos at Lemnos, both connected with metal-working. These traders were also in touch with the Morbihan, possibly through the mediation of western merchants engaged in commerce on the Atlantic seaboard. At home they may have had relations with Crete, the Cyclades, and Hissarlik, and through the last with Cyprus. They were accustomed to erect Cyclopean walls, and learnt the use of cists from the people of the Cyclades. This combined knowledge they carried with them to the western people with whom they traded. The result was the evolution of the dolmen as we find it in the western Mediterranean and along the Atlantic seaboard.

THE *Zoologist* for July contains a most interesting account of the prevalent beliefs concerning animals, their uses, and the *rôle* they play in the mythology of South India, by Prof. Rae Sherriffs. At first sight this contribution might seem to represent no more than a collection of curious beliefs, founded for the most part on very slender knowledge. More closely examined, it will be found to afford a valuable insight into the habit of mind of the less educated portion of the population, which should be thoroughly understood by all Europeans who are engaged in administrative work in India. Having regard to the fact that there is still a great mortality from snake-bite in India, it is strange that the people as a rule have not acquired a more exact knowledge of these scourges. But the belief is still common that the cobra, the best-known snake of India and widely worshipped, is the female, and the rat-snake the male, of a common species. We look forward to the promised continuation of this theme.

UNDER the title of "The Free-living Nematodes of the Gulf of Sevastopol" an important monograph by I. Filipjev has recently been published in the Proceedings of the Sevastopol Biological Station and of the Zoological Laboratory of the Imp. Acad. Sci., Petrograd. This work is of special interest in that it gives for the first time a description of the Nematode fauna of the Black Sea, a group of Vermidea which presents great difficulties from a systematic point of view, and has therefore been less investigated than other groups of Vermidea. Filipjev's work is in three parts :—(1) Systematic, including the description of about a hundred species of Nematodes, of which some eighty are new, and a few new genera. (2) Morphological, containing many new anatomical data. (3) General, giving the topographical distribution and synoptical tables of genera and species.

REPORT No. 108 of the U.S. Department of Agriculture consists of an admirable summary by Nathan Banks of the Acarina or mites "for the use of economic entomologists." This booklet of 153 pages contains a general introduction to the structure and life-history of mites and a synopsis of the families and principal genera of the order, illustrated by nearly 300 figures, and concluding with a bibliography and index. Though primarily intended for use in America, Mr. Banks's work cannot fail to be of service to British students who, not having special knowledge of the Acarina, are called on to classify members of this difficult order. Under the heading "Uncertain Acari" reference is made to the Linguatulida and the Tardigrada; it is somewhat surprising to find the Pycnogonida—which are surely further from mites than any other order referable to the Arachnida—in the same assemblage.

THE current number of the *Quarterly Journal of Experimental Physiology* contains a long and valuable paper by Dr. E. G. Boring on the return of sensation after the division of cutaneous nerves. The author lays great stress on the importance of statistical methods and of the standardisation of the experimental conditions in investigations of this nature. He further points out that the analysis of the nature of the cutaneous sensations, as they return during regeneration of a divided nerve, calls for psychological as well as physiological training. As a result of his own observations, the author has failed to confirm some of Head's observations, and he entirely disagrees with the hypothesis of the existence of "protopathic" and "epicritic" sensibility which was advanced by Head and his co-workers. Dr. Boring considers that the results are best explained on the assumption that single sensory spots are innervated by more than one nerve-fibre and that the multiple innervation is projected upon the central nervous system as multiple excitations; he concludes that the sensory phenomena occurring during the return of cutaneous sensation can be accounted for on this hypothesis.

IN the *Psychological Review* (vol. xxiii., No. 4) Harvey Carr revives the problem of cutaneous sensitivity, as formulated by Rivers and Head in their well-known article of some years ago entitled "A Human Experiment in Nerve Division." The writer challenges the correctness of Head's theory, both from the point of view of the facts and of the interpretation of those facts. The nerve section, he maintains, produced an extremely abnormal condition of the cutaneous tissues, so that peculiarities of sensitivity were to be expected; hence it is not surprising that other investigators have failed to discover what Head calls the protopathic sensibility mediating four functions, and the epicritic mediating three. So far they have only been able to get evidence of the four sensory functions as formulated by earlier writers. Even, however, granting Head's evidence, Harvey Carr submits that the facts do not bear out the interpretation put upon them. He thinks that there is a too general tendency to accept enthusiastically and uncritically Head's theory. The article will prove interesting to many men of science, but particularly to physiologists and psychologists.

IN the Proceedings of the Physiological Society for July, Dr. Edridge-Green records the subjective phenomena produced by gazing steadily with one eye at a rotating cylinder of paper, half of which is black and half white. He finds that the centre of the field of vision appears to be in violent motion of a whirlpool character, and that the white part of the cylinder may appear green or rose-coloured according to the rate at which it is rotated. Dr. Edridge-Green explains these phenomena by supposing that the rods have the

function of supplying visual purple to the cones, and thus increasing the sensitiveness of the latter to the light. The movement seen on gazing at the rotating cylinder is due to currents of photo-chemical liquid (visual purple) flowing towards the fovea in order to sensitise it.

In Memoirs of the Geological Survey of New South Wales, Ethnological Series, No. 2, Mr. Etheridge, curator of the Australian Museum, Sydney, discusses the remarkable cylindro-conical and cornute stones found in the valley of the Darling. All kinds of explanations of their use have been given, some utilitarian, as, for instance, that they were employed as grinders, tombstones, records of the dead, challenge stones, or *bora* message stones; others magical, as used in rain-making and snake-producing, as death bone pointers, and so on. On the whole, it seems clear that they were used by the aborigines for some magical purpose, which may have varied among the different groups which possessed them. But the balance of evidence indicates that they were of a phallic type, and that they were used in some form of fertility rites.

Calcium carbonate in its crystalline forms gains further interest from a paper by Messrs. J. Johnston, H. E. Merwin, and E. D. Williamson (*Amer. Journ. Sci.*, vol. xli., 1916, p. 473). It is shown that the presence of calcium sulphate determines the precipitation of aragonite, a small quantity of the sulphate becoming associated in solid solution in the crystals. Aragonite has been thus obtained at as low a temperature as 19°. A form styled $\mu-CaCO_3$, in scales and hexagonal plates, has been obtained under conditions which are not fully determined. It has refractive indices between 1·550 and 1·650, a density of 2·54, and is unstable in the presence of nuclei of calcite or aragonite, which are less soluble. This form behaves like aragonite with Meigen's test. Useful warnings are given as to the use of this test in the case of mixed materials. Calcium carbonate hexahydrate ($CaCO_3.6H_2O$) is precipitated as monoclinic crystals at temperatures below about 20°; it can be preserved for months in isolated crystals in clove oil as a microscope preparation, but it changes rapidly at ordinary room temperature into calcite and water. The natural forms are carefully considered, and it is suggested that the preservation of aragonite in any but recent geological formations may depend upon its having been kept dry. It may be mentioned that this agrees with the observations of Horwood, Cole, and Little, who show that geologically old aragonite shells are preserved in clays rather than in limestones.

"The Data of Geochemistry," by Mr. F. W. Clarke (U.S. Geological Survey, Bull. 616, 1916) now appears in its third edition, enlarged by some forty pages. The guarded discussion of Brun's results on volcanic gases in the edition of 1911 here receives important modifications; additional references are given to the problems of radio-activity; and even in the treatment of the deposition of carbonates by organisms new observations have been noted. It is remarkable how this book, embodying an enormous range of facts, and without a single illustration, retains its philosophic character and is readable throughout. We turn to it from the ordinary manual of petrography as we might turn from a stained-glass window to a conference with the cathedral founders.

The peridotite with rhombic pyroxene that traverses gneiss in the Sierra de Ronda in Malaya proves to be the source of platinum in the sandy alluvium of the streams. This occurrence is contrasted by MM. L. Duparc and A. Grosset (*Mém. Soc. de physique et d'hist. nat. de Genève*, vol. xxxviii, 1916, p. 253) with the platiniferous dunite of Tagilsk in the Urals; the parent rock and its products of weathering are shown to resemble far more closely those of Khrebet Salatim, which lie farther north on the east flank of the Urals, and were discovered by M. Duparc in 1907. Maps are given of these three localities; the numerous small landscapes from the Ronda district have no great geological interest.

A very interesting and important paper by P. H. Gallé on the relation between fluctuations in the strength of the trade winds of the North Atlantic Ocean in summer and departures from the normal of the winter temperature in Europe appears in a recent issue of the Proceedings of the Amsterdam Royal Academy of Sciences. In a previous paper the author had shown that variations in the strength of the trade winds (15°–25° N., long. 25°–45° W.) were apparent two or three months later in some hydrographical phenomena in northern Europe. The subsequent variations in winter temperature have now been investigated. From an exhaustive comparison of various groups of months for the period 1899–1914 for combinations of five Dutch stations, three German stations, and three in the Far North-west, it was found that the largest correlation was obtained between the fluctuations of the trade wind for the six months May to October on one hand, and those in the temperature for the three winter months December to February following, on the other. The results, based on values computed for 135 stations, are graphically shown by iso-correlational lines on two charts which apply to the trade winds of May to October and of June to November respectively. For the first period the maximum positive value of r, 0·70, is obtained in East Germany, the largest negative, 0·60, in North Iceland and East Greenland. The largest correlation factor for any period was found in that part of Germany embracing the stations Berlin, Görlitz, Posen, and Ratibor, where the relation between the strength of the trade winds over the months June to November and the following winter temperature gave $r=0·85$ and $f=0·04$. By this method a successful prediction was made of the temperature over north-western Europe last winter.

The Meteorological Office has issued a chart dealing with temperature scales which is evidently intended for the use of meteorological observers, but might with great advantage be suspended in every physical laboratory in the country. On the left-hand side of the chart the absolute, the Centigrade, and the Fahrenheit scales of temperature are drawn alongside each other from the absolute zero to 1500° A. of the absolute scale, the divisions being at 10° intervals on the absolute and Centigrade, and at 20° intervals on the Fahrenheit scale. A number of important thermometric points are indicated on the absolute scale, *e.g.* 4° A. helium boils; 43° A. oxygen melts; 90° A. oxygen boils; 234° A. mercury melts; 372·65° A. water boils under one-bar pressure; 505° A. tin melts; 717° A. sulphur boils; 800° A. bodies just red-hot, etc. On the right-hand side of the chart the three scales, from 180° to 330° on the absolute scale, are drawn together, the divisions on the absolute and Centigrade scales being one, and those on the Fahrenheit scale two degrees apart. A number of important meteorological temperatures are indicated—*e.g.* 219° A. the mean temperature of the stratosphere over England, 246° A. the lowest, and 311° A. the highest, temperature observed in the British Isles, etc. The strength of the solar heat stream is given as 135 milliwatts per sq. cm., but there is no indication as to where it has this particular strength.

In the *Times Trade Supplement* for August Prof. H. E. Armstrong strongly urges that, without delay, concerted action should be taken for the complete association and organisation of all the interests connected with the manufacture of dye-stuffs. He argues that the Government has failed to appreciate the requirements of the situation, and has antagonised the interests concerned, and advocates the provision, in place of the body now ruling British Dyes, Ltd., which is described as incompetent, of a satisfactory joint management on which the fine chemical industry shall also be represented. Prof. Armstrong points out that five-sixths of the coal raised in this country is used direct, whilst the valuable volatile matters are conserved only from the remaining sixth. If the whole of the raw bituminous coal were coked at suitable temperatures, large quantities of liquid fuel suitable for use in internal combustion engines would be obtained; there would be a more than sufficient supply of the raw materials necessary for the manufacture of modern high explosives; the raw material for dyes would be more than enough to supply the whole world; large quantities of ammonia would be available for agricultural use; the volume of high-grade gas produced would be more than sufficient for domestic use; and by using the resulting soft coke the open fire could be retained with the advantage that soot and smoke would be abolished and less acid sent into the atmosphere. It has been stated that since the war began ten or more works for the carbonisation of coal at low temperatures (designed on the experience gained from experiments carried out in *this* country) have been erected in Germany, whilst our works are still in the course of erection. Prof. Armstrong urges that the Government should legislate forbidding the use of raw coal, and endorses the suggestion of the President of the Society of Chemical Industry that only the export of coke, not that of raw bituminous coal, should be allowed. Legislation is also necessary for the provision of funds for the study of all problems relating to the development of coking processes, the efficient use of fuels, and the utilisation of by-products. More than 600,000*l*. could be obtained annually for this purpose by placing a tax of only one halfpenny on each ton of coal raised. Not only would all the industries dependent on coal as a basis be developed as a result of such legislation, but our universities would be stimulated in the production of highly trained scientific workers, for whom there would then be a considerable demand.

Circular No. 19, issued by the Bureau of Standards, United States Department of Commerce, consists chiefly of a collection of standard density and volumetric tables issued in connection with the use of the hydrometer for industrial purposes or for the assessment of revenue duties. The confusion which had resulted from the employment of insufficiently defined hydrometer scales, and the lack of a uniform basis for the verification of standards, led the Bureau to investigate the problems connected with hydrometry, and to prepare standard density tables which would serve the purposes of accurate definition. The tables are set out clearly, so that there is no ambiguity as to their meaning or as to the bases on which the calculations are founded. In addition to the main particulars referring to aqueous solutions of ethyl and methyl alcohols, sulphuric acid, and cane sugar, various auxiliary tables are given, including temperature corrections, Baumé equivalents, and reduction of weighings in air to the corresponding values *in vacuo*. The inclusion of various physical constants, and of data for the computation of volumetric capacity from apparent weight of water-content, increases the usefulness of the compilation. A similar production adapted to British requirements might with advantage be made available for use in this country.

We have received Technologic Paper No. 76 of the Bureau of Standards, U.S. Department of Commerce. It contains an account of experiments made upon the determination of the proportion of volatile "thinning" or diluent substances present in oil varnishes.

The trajectory of a body falling freely *in vacuo* forms the subject of a paper by M. A. Viljev in the *Bul. Acad. Sci.*, Petrograd (May, 1916, pp. 643–671). After referring to the work of previous investigators he sums up the results of his own researches thus: 1. In dealing with this problem some authors have used inaccurate equations of motion, while others have not correctly defined the position of the vertical line. 2. A distinction must be made between the vertical line and the plane of the prime vertical at the upper point of the trajectory, corresponding to the initial position of the falling body, and the vertical line and plane of the prime vertical at the lower point of the trajectory, where the fall of the body ceases. At each point the vertical line is defined as passing through the initial position of the body perpendicular to the surface of the equipotential of the full force of gravity, produced through the given point. The plane of the meridian passes through the axis of the earth's rotation and the initial position of the body. The plane of the prime vertical passes through the vertical line as above defined and is perpendicular to the plane of the meridian. 3. On the basis of these definitions it is found that the body swerves from the plane of the prime vertical of the upper point of the trajectory slightly towards the pole. Relatively to the plane of the prime vertical of the lower point of the trajectory it swerves more towards the equator. 4. In falling in a shaft it swerves from the plane of the prime vertical of the upper point of the trajectory towards the equator. Also relatively to the plane of the prime vertical of the lower point of the trajectory it swerves towards the equator.

The Royal Worcester Porcelain Company, Ltd., has sent us some specimens of its porcelain dishes and crucibles for chemical use. As is well known, before the war our chemical laboratories were entirely dependent on material of German origin. This Worcester porcelain has been examined by the National Physical Laboratory, which reports that in regard to all the qualities which can be examined in a short-period test the Royal Worcester laboratory ware is as good as the best laboratory ware hitherto employed, of which the Royal Berlin ware is a typical example. Details are given of the tests, which included the effect of strong sulphuric acid, and 10 per cent. solutions of caustic soda and sodium carbonate, the behaviour of the glaze at high temperatures, the constancy of weight of the dishes, and the resistance to sudden changes of temperature. As regards crucibles, thanks to the purely British industry in fused silica ware, we are almost independent of the quality of porcelain, but for basins porcelain is still essential. For these it is a vital point that material used in one experiment shall not be in part retained by the glaze and carried on to the next, and the National Physical Laboratory report would carry more conviction if greater attention had been paid to this matter. There was a slight *gain* in weight after the treatment with sulphuric acid, and on this the remark is made: "It has not been considered necessary to ascertain whether the increase in weight is due to combination between the sulphuric acid and the material of the glaze or to a slight pene-

tration of the acid in the ware below the glaze." Time would have been better spent in developing this point than in high-temperature experiments, which, for dishes, were superfluous. The ware is made very much thinner than has been customary, and consequently is unduly fragile. In spite of careful packing two of the specimens arrived broken. It is very desirable that we should be independent of foreign supplies of porcelain, and it is to be hoped that the enterprise of the Royal Worcester Porcelain Company and other British porcelain manufacturers will be rewarded, but prolonged use in the laboratory is the only certain means of proving the qualities of the new ware.

MESSRS. WILLIAMS AND NORGATE announce "Raphael Meldola: Reminiscences by those who knew him," with a preface by Lord Moulton and a chronological list of Prof. Meldola's publications. The work will be divided as follows:—Biographical memoir; early years; professor of chemistry; chemical investigator; naturalist; astronomer; personality.

OUR ASTRONOMICAL COLUMN.

THE SOLAR PHYSICS OBSERVATORY.—The report of the director of the Solar Physics Observatory for the year ending March 31, 1916, has recently been issued, this being the third annual report since the transference of the observatory from South Kensington to Cambridge. The work of the observatory has been carried on with difficulty on account of the war, two members of the staff now being absent on military service and two on munition work. Observational work with the Newall telescope and the Huggins instruments was not attempted, but the spectroheliograph was in regular use, photographs of the sun's disc in K_{2-3-2} light having been obtained on 112 days, and of prominences at the limb on 93 days. Sun-spot spectra in the region λ 5300 to λ 5500 were also successfully photographed with the McClean installation. Mr. Baxandall has made considerable progress in the assignment of chemical origins of lines in stellar spectra, and in a revision of the origins given by Rowland for lines in the solar spectrum. The great majority of Rowland's identifications have been confirmed, and terrestrial equivalents for many lines not identified by Rowland have been found by reference to data subsequently published. Experimental work has established the identity of the G group of the solar spectrum with the hydrocarbon band λ 4314 (see NATURE, July 20), and it is thought that a clue has been obtained to the interpretation, in terms of carbon, of the remarkable spectrum of Comet Wells, 1882. In the department of meteorological physics, Mr. C. T. R. Wilson has continued the study of lightning discharges.

With regard to the "Annals of the Solar Physics Observatory," of which vol. iii., part 1, has already been distributed, it is now explained that vol. i. is intended to contain historical and descriptive matter, vol. ii. to refer to stellar investigations, and vol. iii. to deal with work on the sun.

RELATIVE LUMINOSITIES OF SUN AND STARS.—A convenient formula for comparing the luminosity of a star with that of the sun has been given by Mr. C. T. Whitmell (*L'Astronomie*, August, 1916). Assuming the stellar magnitude of the sun to be $-26\cdot5$, and designating the luminosity, parallax, and magnitude of the star by L, p, and m, the luminosity of the star in terms of that of the sun is given by the equation:

$$\log L = 0\cdot0289 - 2\log p - 0\cdot4\ m.$$

In the case of Sirius, for example, where $p = 0\cdot38''$ and $m = -1\cdot6$, $\log L = 1\cdot5093$ and $L = 32\cdot3$, showing that Sirius is about 32 times as bright as our sun. The constant term in the equation depends upon the value assigned to the sun's stellar magnitude, and is equal to $10\cdot6289 + 0\cdot4(S)$, where S is the adopted value.

THE THERMOPILE IN PHOTOGRAPHIC PHOTOMETRY.—The usual method of arriving at the magnitudes of stars shown on photographs is to measure the diameters of the stellar images, or to determine the opacity of images purposely taken out of focus. In either case the result depends in part on the judgment of the observer, and the application of some purely physical method is evidently desirable. Such a method has been devised by Mr. H. T. Stetson, of the Yerkes Observatory, in which the star image is surrounded by a small circular diaphragm, and the intensity of the transmitted beam from a steady source of light, as compared with that of the unrestricted beam, is measured by means of a thermopile and galvanometer. Theory leads to the expectation of a fourth-root relation between galvanometer deflections and stellar magnitudes, and this has been confirmed experimentally. The device appears to have reached a convenient practical form, and measurements of a plate of the Pleiades, for example, indicated a probable error of 0·022 mag. for a single star. An extensive application of the method to the eclipsing variable U Cephei has been commenced, and variations not explained by the eclipse theory have been detected. When provided with a stage having a micrometer screw, and the circular aperture being replaced by a slit, the apparatus becomes well adapted for certain investigations of spectra. In this form it seems likely to be especially useful in the study of colour index, and may possibly aid in the determination of radial velocities of faint stars from objective prism plates taken through a neodymium absorption cell (*Astrophysical Journal*, vol. xliii., pp. 253 and 325).

RECENT INDIAN MUSEUM PUBLICATIONS.

THE latest serial publications of the Indian Museum reach a very high level of excellence. Vol. v., No. 3, of the Memoirs consists of Mr. Stanley Kemp's report on the Decapod crustacea of the Chilka Lake, an area where the density of the water ranges according to season between freshness and a saltness equal to that of the sea. The species, which number 54, include crabs, hermit-crabs, Thalassinids, Caridea, and Peneids. Among the permanent inhabitants, or species capable of withstanding every seasonal change in the water, from fresh to salt, it is surprising to find such characteristically marine forms as Leucosiid and Xanthid crabs, Alpheidæ, and the pelagic Lucifer. The permanent inhabitants constitute 72 per cent. of the whole. The seasonal immigrants (about 7·5 of the whole) all appear, whether normally marine or fresh-water species, to breed in the lake. The casual visitors (about 20 per cent.) are almost all from the sea. Among the 12 species described as new is *Athanas polymorphus*, the males of which are trimorphic. The report is a model of clear and critical exposition, being rich in inference and illustration, but always concise and explicit.

No. 1 of vol. vi. of the Memoirs contains two important papers, one on Indian Tunicata by Dr. Asajiro Oka, the other by Colonel J. Stephenson on Oriental earthworms. The first deals with simple Ascidians and pelagic forms, and does not go much outside the collections made by the *Investigator*. Perhaps the most interesting item is a full descrip-

tion of the extraordinary deep-sea genus Hexacrobylus, hitherto known but imperfectly from a single specimen discovered by the *Siboga* expedition, but now elucidated by five well-preserved specimens dredged by the *Investigator* from 1912 fathoms off Ceylon. In *Hexacrobylus indicus*, which the author regards as an aberrant Molgulid, the body is ovate and covered with delicate hairs; the branchial aperture is a wide transverse slit, ventral in position, and surrounded by six many-lobed tentacles, which collectively resemble thick, prominent, warty lips; the branchial siphon is nearly as large as the trunk itself; the branchial sac is scarcely distinguishable from the œsophagus, and is imperforate and destitute of stigmata, endostyle, and dorsal lamina; the gonads are symmetrically developed on both sides of the body, and the ovaries and testes have separate ducts: though differing from the *Siboga* species, it agrees with it in those features which separate it so widely from all other Ascidians. Another interesting new genus is Monobotryllus, which, though a simple Ascidian, is most closely related to some of the holosomatous compound Ascidians.

Colonel Stephenson's paper, which treats of Oligochæta collected mainly in southern India and Ceylon, though largely anatomical and systematic, is dignified by much instructive comparison and criticism. Twenty species and five varieties are described as new, among them a Pontodrilus from Ceylon remarkable in its habitat, far from the sea, at an elevation of 6200 to 7000 ft. Two new genera are defined, namely, Erythræodrilus from Bombay, apparently related to the Madagascar Howascolex; and Comarodrilus a Megascolecine from Cochin, in alliance with Woodwardia.

Part vi. of vol. xi. of the Records contains three papers of more than common interest. Dr. James Ritchie gives an exhaustive description of *Annulella gemmata*, a remarkable new Hydroid discovered by Dr. Annandale in a brackish pond at Port Canning in the Gangetic Delta. It is a minute form, solitary and usually attached, but also freely locomotive. Its attachment is by a "basal bulb," which alone is invested by perisarc, and is regarded as something between a basal disc and a hydrorhiza. Its tentacles, which are of extreme length, have the cnidoblasts concentrated in whorl-like rings, the cnidoblasts being almost identical with those of Hydra. The usual methods of propagation seem to be non-sexual, but Dr. Annandale, who kept specimens alive, states that minute medusæ are liberated. The non-sexual methods include longitudinal fission, transverse fission of the basal bulb, and the detachment of remarkable planula-like buds.

Dr. Annandale contributes an account, biological and systematic, of sponges parasitic on Indian Clionid sponges. Ten such parasites are reviewed, along with five Clionid hosts, the greater part of the collection being furnished by a few ounces of Madreporarian coral. The methods of attack and defence are discussed very fully. Among assumed methods of protection observed in certain Clionids inhabiting great depths, where the inorganic conditions of life may reasonably be supposed to be constant, is the production of gemmules.

Mr. F. H. Graveley's copious and well-ordered notes on the habits of insects and other Arthropods must be greatly commended. In addition to recording many original observations of behaviour, courtship, breeding, etc., particularly of that retiring group the Pedipalpi, the author has extracted references to multifarious observations published, mainly in Indian journals and in books relating to India, by other writers.

RECENT ECONOMIC ENTOMOLOGY.

THE economic importance of the Coccidæ ("mealy bugs" and scale-insects) is very great, especially in warm countries. It is satisfactory to see, therefore, the first part of an extensive monograph on the Coccidæ of South Africa, by C. K. Brain, published as part 2 of vol. v. of the Transactions Royal Soc. S. Africa (Cape Town, 1915). This contains a general introduction to the study of the family and detailed descriptions of the genera and species of the Pseudococcinæ, Ortheziinæ, Coccinæ, Monophlebinæ, and Margarodinæ. The systematic work has been done with great care, a notable feature being the charts demonstrating in the case of each species the range of variation in the lengths of the antennal segments; the illustrations—photographs and drawings—fill thirteen plates. The author has spared no pains to enlighten his readers, but it was scarcely necessary to include in his glossary the information that "ovum" means "an egg," and "transparent," "so clear as not to obstruct vision."

The *Bulletin of Entomological Research*, vol. vi., part 4, lately issued, contains, as usual, several noteworthy papers. Prof. G. H. F. Nuttall and Mr. C. Warburton describe briefly, with clear illustrations, thirty species of ticks from the Belgian Congo, and point out the importance of each as a carrier of disease. Mr. C. H. T. Townsend, of the U.S. Department of Agriculture, establishes—in reply to some recent sceptical criticism—that Phlebotomus is truly the infective carrier of the Verruga parasite. Dr. G. A. K. Marshall describes, with excellent figures, some weevils injurious to various cultivated plants in India. The highly useful *Review of Applied Entomology* has just commenced its fourth volume, and the first summary in the medical and veterinary series directs attention to the existence of the British and Irish sheep-fly (*Lucilia sericata*) as a pest in the southern United States, together with *Phormia regina*, on the authority of Messrs. F. C. Bishopp and E. W. Loake, in a paper published in the *Journ. Econ. Entom.*, vol. viii., No. 5.

Literature on the common house-fly continues to accumulate rapidly. Mr. R. H. Hutchinson (U.S. Dept. Agric., Bull. 345) contributes same interesting observations on the "Pre-oviposition Period" of the insect, with a view of estimating the value of fly-traps for reducing the numbers of eggs and larvæ. He finds that the term of the female's life before egg-laying varies from 2½ to 23 days, "most of the records falling on the fourth, fifth, sixth, ninth, twelfth, and fourteenth days after emergence."

The larval trombidiid mites known as "harvest bugs" are too familiar as a well-nigh intolerable pest in some localities. Mr. Stanley Hirst (*Journ. Econ. Biol.*, vol. x., No. 4) gives a careful description of this larva under the name of *Microtrombidium autumnalis*. He also describes a Japanese species, *M. akamushi*, which carries the germ of a disease known as "river fever."

In a Technical Bulletin (No. 21) of the Michigan Agricultural College Experiment Station, Mr. Geo. D. Shafer continues the account of his investigations as to how "contact poisons" kill insects. Such gases as sulphuretted hydrogen, hydrocyanic acid, and the vapours of carbon disulphide, benzine, or paraffin affect insects when actually taken up by the tissues, where their presence seems to prevent oxygen assimilation. This result is due to the harmful effect of such gases and vapours on the enzyme-like bodies—reductases, catalases, and oxydases—which are functional in insect tissues. The contact poisons are believed to affect the activities of these enzymes to an unequal degree, thus disturbing their normal balance.

A paper of exceptional value and interest, on the morphology and biology of the green apple aphis (*A. posni*), is contributed by A. C. Baker and W. F. Turner to the Washington *Journal of Agricultural Research* (vol. v., No. 21). This is the "common apple aphid" in North America, as well as in these countries, and the whole life-cycle is passed on the apple. Very full and careful descriptions of the structure of the various forms are given by the authors, who, in the course of their season's work, examined no fewer than 75,000 specimens. Stages in the embryonic development are described, from which it appears that the embryo, after five days' growth, has a long resting period through the colder season of the year, lying in the centre of the winter egg. Of all the results obtained, however, the tracing of the succession through the spring and summer of a number of forms derived from a single stem-mother is the most important. Among the daughters of the stem-mother there may be one winged insect, and interesting "intermediates"—virgin females with rudimentary wings—appear together with the usual winged and wingless aphids. Sexual individuals may appear in the eleventh generation from the stem-mother, the earlier ones appearing as brothers and sisters of parthenogenetic females. The authors believe that temperature is by far the most important factor in determining the appearance of the sexual insects.

A paper by J. R. Malloch, on Chironomidæ and other Diptera from Illinois (Bull. Ill. State Lab. Nat. Hist., vol. xi., 4), is noteworthy because the systematic descriptions of the midges and flies are accompanied by detailed, well-illustrated accounts of the larvæ and pupæ of many genera of Mycetophilidæ, Asilidæ, Bombilidæ, Syrphidæ, and other families. G. H. C.

CHILIAN METEOROLOGY.[1]

ALTHOUGH Chile, in common with other South American countries, has suffered greatly from the conditions brought about by the European situation, the large budget of memoirs recently issued by Dr. Knocke shows little, if any, restriction in the work of the Central Meteorological and Geophysical Institute during 1915. No. 13, part i., of the Meteorological Year Book gives *in extenso* the tri-daily observations carried on at thirty stations during the year 1913, the data comprising barometric pressure, air temperature humidity, wind direction and force (the latter both in Beaufort and by anemometer), cloud, rainfall, evaporation, and exposed temperatures.

In No. 15, part ii., of the Meteorological Year Book the data are summarised in great detail from records kept at fifty-two stations, daily, monthly, and annual abstracts being given. As the stations cover more than 35° of latitude, and range in altitude from 4 to more than 3500 metres, all varieties of climate are to be found among the records. The warmest station, apart from Easter Island in the Pacific, was Arica, mean temperature 19·4° C. (66·9° F.), and the coldest Punta Arenas, 6·3° C. (43·3° F.). The absolute maximum was 38·3° C. (100·9° F.) at San Felipe, lat. 32° 40′ S., height 635 m., and the absolute minimum −8·0° C. (17·6° F.) at Punta Arenas. The effect of the cold Humboldt current in keeping down the temperature is well shown in the data for Arica (lat. 18½° S.) and San Felipe, the mean daily maximum values at the latter station on the mean of the year being 1·7° C. higher than at Arica, 14° nearer the equator, and situated at sea-level. A comparison of the temperature data from Ollagüe, at a height of 3695 metres, with those from Iquique shows a fall of 1° C. for each 323 m., both stations being close to lat. 20½° S.

Great variations in the mean amount of cloud are to be found, the mean annual values ranging from 0·9 at Calama in the north to 8·8 at Evangelistas, near the Pacific entrance to Magellan Straits. At the former station there were 327 clear days (cloud amount less than 2) and not a single cloudy day (cloud amount more than 8), while at Evangelistas only 2 days were clear and 305 cloudy. It is of interest to note that at the island of Juan Fernandez the barometric indications are very frequently an index of those taking place twenty-four hours later on the Chilian coast in about the same latitude.

No. 14 gives the daily rainfall recorded at 112 stations for the year 1913, arranged in parallel columns, thus exhibiting the distribution of the rain throughout the whole length of the country. The wettest station was Cape Raper, lat. 46° 49′ S., long. 75° 36′ W., with 4607 mm. (181·38 in.), the values for December being interpolated. At Calama and Copiapó in the north no rain fell, and ten other stations, all to the north of 30° S., had less than an inch. Hourly rainfall values are given *in extenso* for seven stations. From these records it is seen that torrential rains are uncommon, there being only two instances of more than an inch (25·4 mm.) falling in an hour, the maximum hourly fall being 40 mm. at Contulmo.

We are glad to see that in No. 16 Dr. Knocke continues to give hourly values of all the elements, the station selected in this instance being Los Andes, situated at the foot of Aconcagua, at a height of 820 metres, where the Chilian section of the Trans-andine railway begins. Los Andes enjoys an admirable climate—cool in summer and temperate in winter. Although 300 metres higher than Santiago, the mean temperature is slightly higher, while peaches and walnuts flower a fortnight earlier than in the Chilian capital. No. 17 of the memoirs contains the hourly values for the year 1914 of the principal climatic elements at Santiago, including earth temperature and the electric conductibility of the air observed once daily by means of a Wulff electroscope.

R. C. M.

[1] Instituto Central Meteorológico y Geofisico de Chile, Santiago, Dr. W. Knocke, Director. No. 13, "Anuario Meteorológico de Chile, 1913." Pp. 339. No. 14, "Medidas de agua caída en 1913." Pp. 71+plates. No. 15, "Anuario Meteorológico de Chile." Segunda parte. Pp. 134+plates. No. 16, "Valores horarios de los elementos meteorológicos en Los Andes, 1911 y 1912." Pp. 81+plates. No. 17, "Valores horarios de los elementos meteorológicos en Santiago, 1914." Pp. 91+plates.

THE MOVEMENTS OF THE EARTH'S POLE.[1]

MORE than a century ago it was shown by the mathematician Euler that if the axis round which the earth was rotating were not coincident with the axis of figure, which latter in the case of a spheroidally flattened earth is the shortest axis that can be drawn, the axis of rotation will revolve about the axis of figure in a period which, upon certain assumptions, can be precisely predicted. The time of one revolution of the pole of rotation around the pole of figure depends only upon the shape and degree of elasticity of the earth. In Euler's days the supposition that the solid earth had any appreciable elasticity was so far outside the range of experience that it was not considered by him. He calculated the period of the polar rotation on the assumption that the earth was perfectly rigid, and showed that this period would be about 305 days.

If we determine the latitude of a point on the

[1] Discourse delivered at the Royal Institution on Friday, May 19, by Col. E. H. Hills, C.M.G., F.R.S.

earth's surface by observations of the stars, we are in effect measuring the angular distance between the axis of rotation of the earth and the vertical line, or line through the zenith, at the point of observation. If, now, this axis of rotation moves, the observed latitude of the place will change, and if we prolong the observations over a sufficient time, we ought to find that this observed latitude fluctuates backwards and forwards about a mean value with the same periodicity as that in which the earth's pole of rotation moves round the pole of figure.

Every observer who is engaged in making observations to determine the precise positions of the stars, a class of observation which up to a few years ago occupied a very large fraction of the time and energies of astronomers, is actually continually determining and redetermining the latitude of his instrument. There is thus an enormous mass of latitude observations available for examination, and it should prove a not too difficult task to analyse these with the object of detecting a periodic variation. Two causes, however, militated against success in this inquiry: first, the very small magnitude of this variation; and, secondly, the fact that the earth is by no means rigid, and hence that the true period of the precessional rotation differs very substantially from the Eulerian period of 305 days.

All the earlier attempts to find evidence of this variation were, in fact, hampered by this preconceived notion of the ten-month period; the observations were carefully scrutinised with the view of detecting it, a process, as we now see, foredoomed to failure. It would be a useless task to recount here the various attempts that were made. Two of these, however, I should not like to pass over without notice, those of C. A. F. Peters, at Pulkowa, and Clerk Maxwell in this country.

Peters in his great and classic memoir on the parallax of the fixed stars devoted one section to a discussion on the variability of the latitude in a ten-month period. He found that the actual variation derived from the observations was of so minute a magnitude that it was well within the limits of unavoidable sources of error, and he therefore concluded that if there was any separation of the two poles it was too small to be detected by observation.

Clerk Maxwell examined the Greenwich observations of Polaris in 1851–4, and thought he found some small indications of maxima at about ten-month intervals, but he considered the results as very doubtful, and that more observations would be required to establish the existence of so small a fluctuation.

Substantially the same result was derived by other inquirers. Astronomers were therefore satisfied, up to the year 1884, that the earth's axis of figure was so nearly coincident with its axis of rotation that the difference between the two was inappreciable to the most refined observations. All methods of observation and all principles of the reduction of observations, both of astronomers and of geodesists, were tacitly based upon the idea of absolute coincidence between the two axes.

In 1884 the subject was independently reopened by two men—Chandler in America, and Küstner at Bonn—and entirely fresh light was thrown upon it. Their work was simultaneous and quite independent. I will take Chandler's first.

In 1884–5 he took a thirteen-month series of observations at Harvard with an instrument of his own devising, to which I will revert later. These observations showed a progressive change in the derived latitude, which appeared to him of a greater magnitude than could be accounted for by any instrumental errors. He, however, hesitated to ascribe it to a real change in the latitude without further confirmatory observations, which he could not then make. He therefore put these observations aside, and was, six years later, drawn to re-examine them by the publication of some of Küstner's results, which were also only explicable on the hypothesis of an actual variation in the latitude of the place of observation. It was, however, quite obvious to Chandler that his series of observations contained no warrant for an Eulerian period of ten months, and he therefore, to quote his own words, "deliberately put aside all teachings of theory, because it seemed to me high time that the facts should be examined by a purely inductive process; that the nugatory results of all attempts to detect the existence of the Eulerian period probably arose from a defect of the theory itself, and that the entangled condition of the whole subject required that it should be examined afresh by processes unfettered by any preconceived notions whatever." This bold rejection of theory and appeal to observation alone was rewarded with immediate success, and Chandler was able to show that his observations of 1884–5 contained unmistakable evidence of the rotation of the one pole about the other in a period of, not 305 days, but 428 days. Wherein, then, lay the deficiency of Euler's investigation? As already hinted, this arose from the assumption of rigidity, and it was shown first by Newcomb, and afterwards, more completely, by Hough, that the 428-day period was fully in accord with a degree of elastic yielding of the earth quite consonant with probability. Hough showed that if the earth were as rigid as steel the period would become 440 days; that the actual period is somewhat shorter than this means that the earth as a whole is decidedly more rigid than steel, a result which accords perfectly with other known phenomena which depend upon the earth's elasticity, such as the rate of propagation of earthquake waves.

Immediately following on this initial success Chandler undertook a prolonged and most laborious examination of old observations and reached results which have not completely borne the test of subsequent review. He was confident that the whole movement of the pole might be explained as the superposition of two rotations, one circular, with a 428-day period, and one elliptical, with a period of a year. He thought, further, that there was evidence that the longer period had varied in past times, and that in 1770 it was less than a year. This last result was traversed by Newcomb, who showed its extreme improbability. While fully bearing in mind the lessons of past experience as to the unwisdom of relying too closely upon pure theory, we cannot resist the conclusion that to accept any large change in the 428-day period within recent years would be to set aside the whole dynamical justification for accepting this period as a reality, it being quite impossible to admit that the elastic constants of the earth can be subject to any appreciable alteration within such time as a century or so.

As regards an annual period, we should now prefer to say that, while there are doubtless seasonal transfers of material upon the earth, such as the accumulation and melting of Arctic ice, which may produce a movement of the pole with an approach to a yearly periodicity, the part of the movement due to a true annual period is very small, and is quite masked by large, irregular disturbances. We shall be on safe ground if we say that the observed polar motion is compounded of a precessional rotation in a period of something very near 428 days at an average distance of 20 ft. from the mean pole, with an irregular movement superimposed on it; this irregular movement having sometimes the effect of modifying the rate of

precessional rotation and sometimes of changing its amplitude—that is to say, altering the distance between the pole of rotation and the mean pole—according as it is acting parallel to, perpendicular to, or at any intermediate angle to the direction of the precessional rotation. I shall revert to this question later, and show how it is possible by a simple graphical construction to separate out this irregular motion and construct a diagram of it which should be helpful in elucidating its cause.

While it is thus to Chandler that the credit of discovering the 428-day period should be ascribed, it is to Küstner that we owe the first real proof that there is an actual variation in the latitude of a point upon the earth.

Küstner's observations were made in the same years as Chandler's, 1884–5, and were designed to determine the constant of aberration, a class of observation identical with those which would be used to determine the latitude of the place. Upon reducing these observations the results were at first sight anomalous in that they gave an impossibly small value of the aberration constant. The anomaly was not due to any instrumental cause; it could not be due to any seasonal change in the refraction, as the morning observations of 1884 were not accordant with the morning observations of 1885, nor could it be explained by any possible error in the proper motions of the stars. Küstner was thus enabled to state positively that the latitude of the place of observation had actually changed. It must be admitted that the years 1884–5 were particularly favourable ones, and that both these astronomers were in a sense lucky in having chanced upon them. The movement of the pole happened at that time to be exceptionally rapid. I do not, however, mention this as detracting in any way from the merit of their achievements; they deserve to be remembered as simultaneous but independent discoverers of this important and interesting phenomenon, and should be honoured, Chandler especially for his courageous rejection of mathematical theory, and Küstner for the very high skill and exquisite refinement of his observational work.

The importance of Küstner's discovery was at once recognised upon the Continent, and a proposal was made to the International Geodetic Conference to establish a chain of stations for carrying on a series of simultaneous observations and thus deducing the true law of this latitude variation. The suggestion was soon carried into effect. Six stations were chosen, all at the same latitude, 39·1° N.—Carloforte, in an island close to Sardinia; Mizusawa, in Japan; Gaithersburg in Maryland, and Ukiah in California—all new stations, where special observatories had been built for the purpose; a new observatory, established by the Russian Government at Tschardjui, in Russian Asia; and the existing observatory at Cincinnati. The reason for selecting stations at the same latitude was that identical sets of stars could be observed at each place, and thus any errors due to defective knowledge of star places are similar for all. These began work in 1899. Later, two stations in the southern hemisphere, at latitude 31·5° S.—Bayswater in Western Australia, and d'Oncatwo in the Argentine—were added.

The results were reduced and discussed by Prof. Albrecht at the Geodetic Institute, Potsdam, and published with a diagram showing the actual polar movement as deduced from the mean of the observations at all the stations, from time to time.

It was not long before these observations yielded a result of the highest interest. The observatory which devoted itself most whole-heartedly to the work, and at which the observations were most extensive and most precise, is that in Japan. This was under the able direction of Prof. Kimura. By a searching discussion of the whole series of observations he showed that they became far more consistent if a new term were introduced into the expression for the latitude variation, this term having an annual period, but being independent of longitude and having the same value for all the stations at the same date.

It will be readily seen that this term differs completely from those we have been considering hitherto. It is not a shift of the earth's axis or a movement of the pole of rotation; as it affects all places along a parallel of latitude equally the pole evidently does not move, but something which has an effect exactly the same as if the centre of gravity of the earth were shifted a few feet up and down, northward and southward, from its mean position.

The great difficulty in elucidating the Kimura term lies in its extremely small magnitude and in the consideration that there are so many possible sources of error affecting observations of this class which might have annual periodicities that their separation and evaluation are extraordinarily complicated questions. This is not the place to attempt any complete discussion, but a mention of some of the lines along which a solution has been sought may detain us for a few minutes.

The magnitude of the term at the latitude of 39° is about 6/100ths of a second of arc, or 6 ft. on the earth's surface. It has the same value and phase for every station on the same parallel and is zero on about March 9 and September 12, and maximum and minimum on June 10 and December 10, *i.e.* about ten days before the equinoxes and solstices respectively. It cannot be accounted for as a real shift of the earth's centre of gravity. It is true that in the alternate melting and accumulation of ice and snow at the two poles we have a periodic factor at work which does do this, but the amount is far too small. It was pointed out long ago by Van de Sande Bakhuysen that to fit in with the observed value of this term the apparent path of the centre of gravity must have an amplitude of 3 metres, which, if translated into terms of polar ice, would mean that a cap of ice one kilometre thick and 244 square degrees in area would have to form and disappear each year. This is obviously quite impossible. There are certain possible errors in the accepted values of the proper motions and parallaxes of the fixed stars which might produce an apparent variation in the observed latitude of this nature. As all parallaxes are based upon differential measures we cannot with certainty say that such errors are impossible; we can only say that they appear to us very unlikely, and that, if they were actually proved to exist, our ideas of the stellar universe would be profoundly modified.

If there were a yearly term in the refraction which had the effect of a periodic change in the apparent zenith we should get a corresponding periodicity in the observations. If, for example, there were a solar atmosphere, even of a quite tenuous nature, which extended into space beyond the earth's orbit, we should get a seasonal change due to the varying angular distance of the sun from the zenith of the place of observation. An atmosphere which could bend rays of light to the requisite amount, though undoubtedly extremely rare, would, however, be dense enough to offer an amount of resistance to a planet, or *a fortiori* to a comet, inconsistent with observed facts. It is, however, quite possible that the changing declination of the sun may curve or tilt the mean isobaric surfaces in the upper atmosphere in such a way that the

apparent zenith moves north and south about its mean value, and that it is to this cause we owe the greater part, if not the whole, of the Kimura term. Such a displacement of the isobars is highly probable, and the phase times of the latitude variation—nil at equinoxes, maximum northward at summer solstice, and maximum southward at winter solstice—fits in perfectly with this explanation. The observations made in the southern hemisphere should form a crucial test. If this is the true cause the apparent latitude of a southern observatory will be shifted in the same direction as that of its northern counterpart, *i.e.* northward in June and southward in December. We have only a short series of observations from southern stations, but so far as they go they appear to conform. There is thus fairly strong evidence in favour of this explanation.

It must not, however, be assumed that the matter is settled beyond dispute. More observations are necessary, and especially observations at widely different latitudes. The international stations are, as to the northern ones, almost exactly on a parallel, and, as to the southern ones, on a parallel differing only by $7\frac{1}{2}°$ from the northern. This uniformity, highly advantageous for securing a precise record of the motion of the earth's pole, is disadvantageous for solving the riddle of the Kimura variation, and other places should join in the attack. Unfortunately the observations are very laborious and require the almost exclusive attention of an observer. There is, therefore, a very real want of an instrument which shall demand something short of the whole time of a skilled astronomer. With this object, and also with the intention of eliminating certain sources of error, instruments of new form have been devised. A short account of these will be of interest.

I shall not here attempt any description of the methods of observation used. It will be sufficient to say that, as what we want to find is the direction of the zenith at the place, all methods ultimately depend either upon a level, giving us the horizontal plane, or upon a plumb-line, giving us the vertical, and that of these two the level is the one that has almost exclusively been employed by the astronomer. The level is an instrument capable of a high degree of precision, but it has the disadvantage of being very susceptible to temperature changes, and, as both the glass tube of the level and the spirit with which it is filled are bad conductors of heat, it is impossible to ensure that it is at an even temperature throughout. Irregularities are thus produced which the reading of both ends of the bubble only partially eliminates. The mere fact of an observer standing near a sensitive level to read it may seriously vitiate its accuracy.

Some of these errors may be avoided, and such errors as are due to faulty reading of the level graduations by the observer entirely eliminated, by making the level an integral part of the instrument by floating the whole in liquid. The first application of this principle to an astronomical instrument was by Chandler, who carried out his series of latitude observations, already mentioned, with an almucantar, being a transit telescope floated in a trough of mercury. The name "almucantar" means a small circle of the heavens parallel to the horizon, and it will be sufficiently obvious that if the telescope can be set at any angle with the float, then as the instrument is rotated in the trough, or the whole trough itself is turned, the line of sight of the telescope will move round such a circle. With this instrument the stars are observed, not as in a transit circle crossing a vertical line, but crossing a horizontal circle of constant altitude. For convenience of calculation this horizontal circle would generally be selected as that through the celestial pole at the place. Chandler's instrument was purposely designed so as to differ as little as possible from the ordinary visual type, and must have been a most difficult instrument to use. The fact that he got such excellent results from it is no small tribute to his manipulative skill. The use of this form of instrument cannot be said to have found great favour among astronomers; there is only one example of it in this country, and, so far as I know, none on the Continent. The one we have is at the Durham University Observatory, and was designed by the present Astronomer Royal for Scotland, in co-operation with the late Dr. Common. It marked a very decided advance upon the earlier type. In two points specially, the screen of the floating part from wind disturbance, and the attachment of the eyepiece to the fixed part, the designers had the idea of a movable instrument, which a slight touch or a puff of wind would set vibrating to such an extent that no observation would be possible for a minute or two, clearly before them. The almucantar method of observation, meaning by this, not the use of a floating type of instrument, but the observing of stars crossing a horizontal circle, though appropriate for the particular class of observation we are here concerned with, those for determination of latitude, is not absolutely the best that can be used. To reduce every possible source of error to a minimum, particularly those due to refraction of the atmosphere, we want to observe stars as near the zenith as possible.

The floating principle has been applied with great success to a zenith instrument in the Cookson floating zenith telescope now at Greenwich, designed by the late Bryan Cookson, whose early death was a great loss to astronomy.

It is a photographic instrument, with a telescope or camera tube attached to a circular float which floats in a ring-shaped trough of mercury. The angle between telescope and float can be altered so that it can be clamped to point either vertically upwards or at any angle, up to about 30°, from the vertical. It is used in the well-known Talcott method. A pair of stars is selected which cross the meridian within a few minutes of each other at nearly the same zenith distance, one north and one south of the zenith. The instrument is set so as to include the first star in the field, the lens is opened, and as the image of the star moves across the plate it traces a fine line or trail. After the star has crossed the meridian, the telescope is turned through 180°, leaving tube and float clamped in the same relative position, and the second star traces out its trail. The distance between the two trails on the plate, which is small if the difference of their zenith distances is small, when the appropriate corrections are applied, gives the observed difference of zenith distance of the two stars, and, therefore, the observed position of the zenith, and hence the latitude of the observer. By repeating the observation with a number of pairs of stars a very precise determination of the latitude is made.

Recently a zenith telescope, designed, not on the floating, but on the hanging principle, finding the vertical line by virtue of its free suspension in a gimbal ring, has been constructed, and would have been at work by now had it not been for the interruption caused by the war. Though it has thus not yet been tested by practical experience, a few words on it may not be out of place. The method of observation will be the same as I have just described, except that there is no arrangement for clamping the instrument at an inclination to the vertical; it is intended to be used only in the vertical position, and the angle covered by the photographic plate will be a few degrees from the zenith on each side. Exactly how far we can go

from the zenith depends upon the qualities of the lens, and no confident statement can be made until this has been tested, but it is hoped that star trails perfectly sharp for measurement will be secured up to an angular distance of 3° from the centre. This gives us as available for our purpose the stars over a belt 6° wide down to the sixth, and possibly the seventh, magnitude. The actual work of observing will be very simple, and will only mean that the whole instrument is rotated through 180° at certain prearranged times, and that the lens is opened after twilight and covered before the dawn. It would be possible for this to be done by mechanism controlled by a clock.

As the telescope hangs freely always in a vertical position, we entirely get rid of one of the astronomer's anxieties, the risk of error due to flexure or bending of his telescope, for though the tube can be made apparently very rigid, the excessively minute degree of bending sufficient to introduce appreciable errors is difficult, if not impossible, to avoid in a telescope which has to be used in different positions. Then, again, the errors due to changes of temperature inside or close to the instrument should almost disappear in this form. First, no temperature changes affect the suspension; so long as the body of the telescope remains undistorted the position of the true vertical in regard to the optical axis remains constant. Secondly, as the whole hanging part of the instrument is perfectly symmetrical about the vertical axis, with the trifling exception that the plate-carrier and photographic plate are not circular, but rectangular, no temperature change should distort the axis. Any distortion that can take place will, in fact, be the very small change of scale that will result from the difference in the expansion of the glass plate and the brass tube. Thirdly, it is possible, and in this instrument has been done, to enclose the whole in an outer case which can be made air-tight and kept at a constant temperature by a thermostat. In order to close the instrument in front it is necessary to have a plane parallel glass of slightly larger aperture than the lens. As this glass has to be worked with the same refinement as a lens, and as a plane surface is more troublesome to work than a curved one, this is rather a costly addition. Whether, as a matter of fact, it is worth while keeping the instrument at the same temperature, or whether it will be better to reduce the temperature change to a minimum by covering the whole with non-conducting material, and then apply the very small corrections necessary to the measurements made on the plate, is a question for experience to decide.

As a heavy hanging mass would be liable to long-continued vibrations when disturbed, a four-armed vane attached to a rod at the base is immersed in a dash-pot or bath of glycerine. This rod must be centred in prolongation of the vertical axis, otherwise the capillarity between rod and liquid will introduce a force deflecting the telescope from the true vertical. While it would thus appear that in this form of instrument most of the familiar sources of error are minimised, it is interesting to note the introduction of one possible cause of error, quite unfamiliar to astronomers, namely, the deflection that might be due to the attraction of the earth's horizontal magnetic force upon the hanging part. If the telescope-tube were, as is customary, made of iron or steel, this would reach a serious magnitude, and even if a proportion only of the suspended weight were of iron a perceptible deviation might result. It would, in fact, not be safe to allow this proportion to exceed one-tenth of the whole weight, and it therefore seemed better to exclude the use of iron or steel altogether. There is accordingly none, with the exception of the four thin flat pendulum springs which form the gimbal suspension.

In detaining you with these short descriptions of recently devised instruments, I may appear to have been wandering rather far from my subject, the wanderings of the earth's pole. You will, however, appreciate that in reality they follow very closely from it, being instruments designed with the special object of solving the particular problem we are discussing.

We will now revert to the diagram of the observed polar motion, and I will indicate how it is possible to analyse this so as to separate the irregular movements from the more orderly fourteen-month preces-

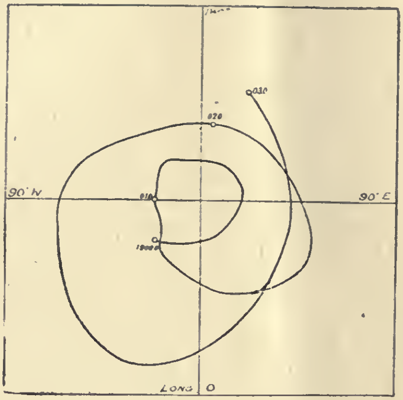

FIG. 1.—Track of polar movement, 1900–3.

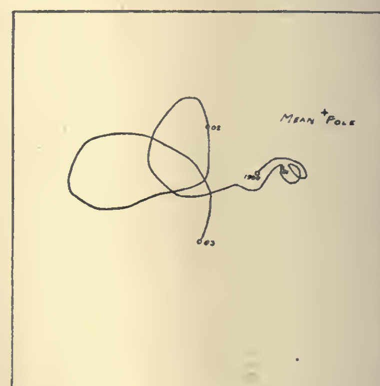

FIG. 2.—Same track referred to axis rotating in the earth with a fourteen-month period.

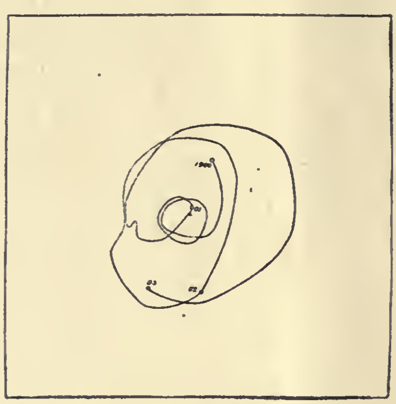

FIG. 3.—Hodograph of Fig. 2.

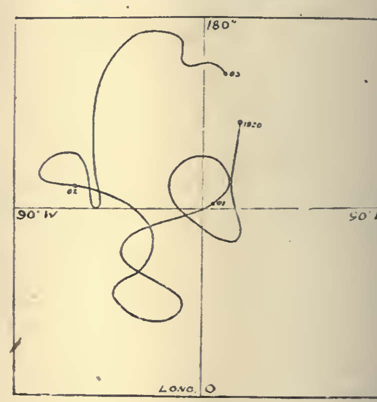

FIG. 4.—Hodograph referred back to axes fixed in the earth, or torque diagram.

sional rotation. We are justified in assuming that this free precessional period is constant in duration and therefore determines the average rate of rotation of the pole of revolution. If, therefore, we take a diagram of the polar movement, which will naturally have its axes of reference fixed in relation to the earth, and convert it into another diagram, showing the same movement, referred to axes rotating in the earth at the average rate of the precessional rotation, we obtain a graph of the irregular part of the polar path. If this irregular part has any well-marked annual period, such period ought to be apparent on inspection of the converted diagram. In the actual diagrams obtained there seems little or no evidence of the existence of a yearly term.

We now take the second diagram, and by the well-known process construct its hodograph, the curve which gives us a measure of the amount and direction of the force which could have caused the movement recorded in diagram No. 2. This will still be referred to the moving axes, so is not directly available for deducing the true direction of these forces in the earth. Before we can do this we must refer the diagram back again to axes fixed in the earth. Thus, finally, we obtain our diagram No. 4, which may be called the torque diagram, as it represents in direction and relative magnitude the torque or twisting force which has been acting upon the earth to produce the observed movement of the pole.

The interpretation of such a diagram is a somewhat complex matter, and has not yet advanced far. The causes that seem to be at work producing the irregular shift are either movements of the earth's crust, slow or rapid, as in an earthquake; the transfer of Arctic ice from one point to another, or its accumulation and disappearance so far as this takes place unsymmetrically with respect to the earth's axis; and possibly extensive barometric changes extending over considerable areas.

Of these the transfer of ice is the largest factor and is probably the one to which most of the irregular polar movement may be ascribed. An earthquake, even of gigantic dimensions, would have an almost negligible effect. The late Prof. Milne estimated that a very large earthquake might displace ten million cubic miles of earth through a distance of 10 ft. horizontally or vertically. Such a vast cataclysm would only change the position of the pole by a few inches.

In conclusion it will be an act of natural curiosity to inquire whether there is any evidence of the amplitude of these polar wanderings having been greater in past times than at present, and whether there is any likelihood of their being greater in the future. To both these questions the answer is "No." The axis of rotation is always kept near the axis of figure by internal friction, and it would require a large change in the distribution of mass to move the axis of figure very far.

As regards the future, the probabilities point still more strongly in the same direction. Each shrinkage of the earth, whatever its immediate effect on the position of the axis of rotation may be, tends ultimately to bring it nearer to the axis of figure or principal axis of inertia, and therefore tends to reduce the average amplitude of the polar path. The distance of the pole of rotation from the mean pole will therefore gradually decrease as the world grows older, while at the same time, as the earth cools and becomes less elastic and more rigid, the rate of rotation will quicken.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Marquess of Crewe has been appointed President of the Board of Education, in succession to Mr. Arthur Henderson, resigned.

THE honorary degree of doctor of laws has been conferred upon Dr. Otto Klotz, of the Dominion Astronomical Observatory, Ottawa, by the University of Pittsburgh.

AN explanatory circular respecting the programme for technical schools and classes for the session 1916–17 has been issued by the Department of Agriculture and Technical Instruction for Ireland. The regulations which were in operation during the session 1915–16 will continue in force with some few alterations, among which we note that a school will not be recognised as a technical school under the conditions of section ii. (*a*) of the programme unless there are at least twenty approved introductory and specialised course students in attendance in any session, of whom not less than 50 per cent. are specialised course students. Teachers recognised for grants under the conditions of the third paragraph of the explanatory circular will not be recognised for this purpose as specialised course students. The case of schools of a special character will receive special consideration, and, if it is thought desirable, this regulation may be modified in the case of such schools. Grants will not be paid upon the attendance of a student at more than one lesson in the same syllabus on the same day, unless there is an interval of at least 15 min. between each lesson. Instruction in the first-year syllabus of a subject of a specialised course will not be permitted to be given concurrently by the same teacher with instruction in any other syllabus or subject.

A REPORT on Indian education, 1914–15, by Mr. Sharp, educational commissioner with the Government of India, has recently been received. The report is a very brief narrative of the main lines of Indian educational progress, and consists of twenty-seven pages (quarto) of letterpress and fifty-seven pages of tables. In addition, something like fifty interesting illustrations are given of educational buildings of different grades and classes which have been completed during the twelve months under review, and of the arrangements in such buildings. When it is considered that all forms of education are dealt with, from university standards down to primary schools, with an area about fifteen times as large as the United Kingdom, with a number of pupils of between seven and eight millions, and at a cost of eleven crores of rupees (that is, more than 7,200,000*l*.), it will be understood that a volume of the size mentioned represents almost the utmost limits of condensation. The effects of the war in Europe have been very distinctly felt in India, in the first place, in the desirability for economy, though even here it was found that the expenditure for the year under review was about 90 lakhs (nearly 600,000*l*.) higher than in the year previous to the war. The increase appears to have been mainly due to the rapidly increasing number of pupils in the schools, etc.; for in the five years up to 1914 the numbers had increased by no fewer than one and a third million pupils. The war, however, has affected the higher educational institutions more than the lower, for a good many of the British professors in colleges, etc., are now on military service. It is noticeable that pamphlets, such as "Why Britain is at War" and others, have been widely distributed in several of the Indian vernaculars to pupils. Also other means, such as lectures, etc., have been taken

to put the war in its proper light. On the other hand, though it was known that Germany had long maintained a regular organisation of propagandist schools throughout the world, it was not until July, 1915, that steps were taken by the Government of India to intern or repatriate the enemy aliens in India who were engaged in school work, when such schools were handed over to other agencies.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, August 7.—M. Paul Appell in the chair. C. **Richet**: The monthly variation of natality. For a period of fifty-seven years the maximum number of births is in February or March. For the years 1906–10 the maximum in these two months is shown in all countries in the Northern Hemisphere, and figures for eleven countries are cited. In the Southern Hemisphere the monthly maximum is in August–October, or a period six months from the maximum in the Northern Hemisphere. The maxima are in the same months both for legitimate and illegitimate births, for rural and urban populations, for the poor and rich; but a relation can be traced between the latitude and the date of the monthly maximum.—C. **Camichel**: Hammering in water mains: the examination of the state of a main. P. **Choffat**: The volcanic intrusive rocks of the region situated to the north of the Tagus.—E. **Belot**: Experimental volcanoes and the laws of volcanic phenomena. The experimental arrangement described in an earlier communication can be modified by the introduction of a layer impermeable to water and steam (slate) above the source of heat.—R. **Souèges**: The first divisions of the egg, and the origin of the hypophysis in *Capsella bursa-pastoris*.

BOOKS RECEIVED.

Théorie Générale des Nombres: Définitions fondamentales. By E. Dumont. Pp. 92. (Paris: Gauthier-Villars et Cie.) 2 francs.

Petit Atlas Céleste. By G. Bigourdan. Pp. 57. (Paris: Gauthier-Villars et Cie.) 2 francs 75 centimes.

Le Climat de la France: Température, Pression, Vents. By G. Bigourdan. Pp. 135. (Paris: Gauthier-Villars et Cie.) 4 francs.

Mitteilungen der Naturforschenden Gesellschaft in Bern. 1913. Pp. xxxv+266. 1914. Pp. xxv+324. 1915. Pp. l+315. (Bern: K. J. Wyss.)

Centenaire de la Société Helvétique des Sciences Naturelles. Band l. Pp. vi+316. (Basel: Georg and Co.)

Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band li. (Basel: Georg and Co.)

Actes de la Société Helvétique des Sciences Naturelles, 97me Session. 2 Pts. (Aarau: H. R. Sauerländer et Cie.)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft, 1914. 2 Pts. (Aarau: H. R. Sauerländer et Cie.)

The Sea-Trout. By H. Lamond. Pp. xi+219. (London: Sherratt and Hughes.) 21*s*. net.

Observations made at the Royal Magnetical and Meteorological Observatory at Batavia. Vol. xxxv. (1912.) Pp. xxvi+96. Observations made at Secondary Stations in Netherlands East-India. Vol. iii. (1913.) Pp. ix+119. (Batavia: Government Printing Office.)

Results of Registering-Balloon Ascents at Batavia. By Dr. W. van Bemmelen. Pp. lvii+109. (Batavia: Javasche Bockhandel en Drukkerij.)

Regenwaarnemingen in Nederlandsch-Indië. Zes en Dertigste Jaargang, 1914. Deel ii. Uitkomsten. Pp. ix+230. (Batavia: Landsdruckkerij.)

Oceanographische Waarnemingen in den Indischen Oceaan, Sept., Oct., Nov. (1856–1914). Tabellen: Observations Océanographiques et Météorologiques dans l'Océan Indien. Pp. xi+240; Kaarten 25. (Utrecht: Versluys and Scherjon.) Text and atlas, 6.50 florins.

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THURSDAY, AUGUST 31, 1916.

A SURGICAL BOOK FROM THE FRONT.

Surgery in War. By Major A. J. Hull. Pp. xv+390. (London: J. and A. Churchill, 1916.) Price 10s. 6d. net.

THIS handbook is described in the introduction by Lieut.-Col. E. M. Pilcher, R.A.M.C., as a *résumé* of current practice and experience at the front; and the fact that Sir Alfred Keogh, the Director-General of the Army Medical Service, has written a preface to it stamps it as, at any rate, "semi-official." It has, therefore, an interest apart from its strictly surgical aspect, and although, as Sir Alfred Keogh remarks, "the views expressed therein may not command assent in every quarter," they demand careful and sympathetic consideration.

The author has enlisted the service of several of his colleagues who have had special experience in certain types of cases and have written the sections of the book corresponding to their own particular speciality: Lieut.-Col. Harrison discusses the bacteriology of wounds in war; Dr. Greenfield, the general condition of the wounded and wounds of the abdomen, and he is also responsible for the illustrations; Lieut. Tanner, the treatment of wounds by saline solution; Capt. Snowden, injuries to peripheral nerves; and Lieut. Edwards is responsible for the radiographic section of the book.

The treatment of a wounded man can be considered in three stages. The first is to combat shock and arrest hæmorrhage; the second is the great fight against infection; while the third is the effort to restore the damaged part to its normal function and the injured man to his normal health.

For the first of these stages the author strongly advocates the free use of morphia given in full doses—that is to say, until the patient is well under its influence and his pain has been materially subdued. This treatment will meet with fairly general approval. It is interesting to note that the Service affection for initial-letter abbreviations has reached even to the morphia bottle: the dose recommended is I.M.H. gr. $\frac{1}{4}$.

The author is not in favour of stimulants, and it is possible that in this he is regarding shock from an ultra-academic point of view. It is hard to define exactly what is meant by shock, and it is quite possible that a treatment which is not suitable for "shock" as defined, for example, by Crile may be quite a good one for a wounded man. It may be easy to draw laboratory distinctions between shock and collapse, but it is not easy to say where one begins and the other ends when confronted with what one of our statesmen so aptly calls a "heap of bloody rags."

Injection of saline solution is not recommended "unless there has been hæmorrhage," as its effects are transitory. This remedy is of course often disappointing in its results, but it would be a great pity if so simple a method of treatment were discredited. It is not easy to say how much blood a man has lost, and unless the saline injection be excessive in amount, it is hard to see what harm is done, especially if the other methods of relieving shock be adopted as well.

The warning on p. 30 against keeping a patient too long on a restricted diet is very much to the point: this error is probably a survival of the ancient doctrine of "starving a fever." A patient, however, who, in addition to prolonged physical fatigue and mental strain, has to combat a severe suppuration lasting often for weeks or even months requires as generous a diet as he can digest and assimilate.

The second phase of the surgeon's work is the struggle against infection, and in this connection the author is a strong supporter of the "strong salt" or "salt-bag" treatment, and equally opposed to the use of chemical antiseptics. To quote from p. 66: "I have found the results of treatment by hypertonic solution superior to any antiseptic treatment. . . . The ordinary antiseptics, iodine, boric fomentations, peroxide of hydrogen, and alcohol dressing, have appeared to me decidedly inferior to the saline treatment. The strong antiseptics—for example, pure carbolic—have not been used in my wards."

This quotation is an ample explanation of the author's distaste for antiseptics. Iodine is so readily rendered inert by albuminous material as to be practically useless for a discharging wound; boric acid is a feeble germicide, and its main value is the prevention of secondary infection; while peroxide of hydrogen and alcohol must, from their physical properties, exert a very transient influence.

In an earlier section the author quotes the results of treating wounds with strong antiseptics early in their course, and sums up strongly against them. The evidence which he quotes of twenty-seven cases treated with pure carbolic acid—he does not say exactly how—is not very satisfying.

The whole subject of the disinfection of wounds by chemical antiseptics has been argued with an enthusiasm which has at times almost carried with it a sort of "odium theologicum." This is, however, merely an indication of the sincerity of the protagonists. There are undoubtedly many wounds which it is impossible to disinfect, if for no other reason than that the patient is unable to bear the severe operation which would be necessary, in order to open up the remote recesses of the wound and apply the antiseptic, until the infective process has gained too firm a hold for it to be stamped out. There are times, too, when the necessary *personnel* and equipment for such treatment are not available, and this must be so; but there are wounds which can be cleaned surgically, and there are occasions when opportunities for carrying this out are present, even if on rare occasions.

There is a solution commonly called "Lister's strong lotion," which consists of 5 per cent. carbolic acid containing 1/500th part of perchloride of mercury. This can be applied freely and thoroughly to wounds, and in some cases is successful in disinfecting them, even when bone has been

involved. But it must be allowed some time to act, and must be applied thoroughly to every part of the wound, not neglecting to remove foreign bodies and provide for the due drainage of the wounds. Further, it and all other antiseptics must be applied early, since when the wound is actually suppurating they are of little value, and in such cases the patient's own resisting power, aided by drainage, irrigation, artificially induced lymph discharge, or other methods of removing the bacterial toxins, is the main factor ensuring his recovery.

The author is almost as much opposed to the use of hypochlorous acid and its salts. He only makes mention of "Eusol," which has not the valuable property of hypochlorite of soda—namely, of dissolving sloughs, which of itself aids materially in facilitating drainage. Those who have seen stinking wounds become sweet very rapidly under the application of this group of disinfectants, or have seen wounds of the mouth treated with Chloramine T, will feel that these substances deserve stronger commendation.

In the sections of this book devoted to the third phase of the surgeon's work there is less disputable matter. In operations the use of local anæsthesia, supplemented if necessary by a general anæsthetic, is advocated, and for the treatment of the various groups of injuries excellent and definite rules are laid down, one of the best sections being that on injuries of the peripheral nerves.

The book is illustrated with a number of simple drawings of splints and apparatus, which might perhaps be amplified in a succeeding edition, showing more exactly the details of their use. The mass of compound fractures which has come for treatment has resulted in the invention of numerous, ingenious, practical devices for their fixation, and for a surgeon to avail himself of these, it is necessary that he should have exact working details—for example, how to take the appropriate measurements, and also, in the case of more elaborate apparatus, where to procure the same. There is also an interesting series of skiagrams taken by Lieut. Edwards, the majority of which show bullets in various situations in the body. Might it be suggested that some of these plates, which for the most part give no guide to the practical surgeon, could be replaced with advantage by photographs of the various splints as fixed to actual patients?

THE WORTH OF CHEMISTRY.

Chemistry in the Service of Man. By Prof. Alexander Findlay. Pp. xiii+255. (London: Longmans, Green and Co., 1916.) Price 5s. net.

THIS book is based upon a course of lectures delivered in 1915 by the author to the United Free Church College at Aberdeen. As a teacher of chemistry Prof. Findlay rightly considered he could do no more useful service than to give his hearers, who would otherwise have little opportunity of becoming acquainted with such matters, some information concerning what the science of chemistry has been able to accomplish in the "uplifting" of mankind and in promoting its material well-being.

Although originally addressed to a Scottish audience, the author, in the selection and arrangement of his subject-matter, has been guided by other considerations than the purely utilitarian. His hearers, as a body, were presumably sufficiently enlightened to appreciate the philosophic vein which runs through the method of its presentation, and were able to set a proper value on his attempts to elucidate the abstract principles he sought to inculcate. His purpose was to recount not merely "the manifold ways in which chemistry has revolutionised life and has contributed, on the material side, to a civilised existence," but also to indicate "some of the principles which underlie chemical change and some part of the contribution which chemistry has made to our knowledge of the constitution of matter." In this happy blending of the philosophic and purely scientific with the utilitarian and material the book may be said to fulfil the ideal of what such a work should be. The author treats his theme with the dignity and reverence which, as a teacher imbued with the true spirit of science, he feels instinctively they merit. The doctrine is sound and accurate, and is set forth in sufficient fullness for the immediate purpose of exposition. At the same time the lay reader, for whom of course the book is mainly intended, will not be wearied or his interest weakened by technicalities or discussions of purely abstract principles. The tactful manner in which Prof. Findlay has managed to steer a middle course in this respect is a characteristic feature of his work. Moreover, he has not been unmindful of the signs and portents of the times. They have afforded him ample material for a lay-sermon, which he has not failed to drive home. The appearance of such a book at the present juncture is therefore most opportune.

The work opens with an exordium in which the province and scope of chemistry, both as a science and an art, are clearly and succinctly defined. It presents, as might be anticipated, no special features of novelty to the trained chemist, but it is well written, and is a good illustration of Prof. Findlay's power of lucid exposition and clear thinking. In a few comprehensive statements he traces in broad outline the developments of the conception of the atomic constitution of matter, the gradual recognition of its various elementary forms, and of the distinction between elements and compounds; the perception that the form of energy with which chemistry is specially concerned acts in accordance with definite laws, and that it is a science of quantitative relations capable of rigorous mathematical treatment. On the basis of this preparatory ground-work he proceeds to illustrate and explain, in about a dozen chapters, some of the most important achievements of the science, each chapter dealing with a specific subject or group of correlated subjects, such as Combustion and the Production of Fire; the Chemistry of Illuminants; Energy, Fuel and Explosives; Cellulose and Cellulose Products;

Velocity of Reactions and Catalysis; Fixation of Atmospheric Nitrogen; Glass, Soda, Soap; Electricity and Chemistry; the Colloidal State; Molecular Structure; and Synthetic Chemistry.

The mere enumeration of the titles of the several chapters will serve to show the range and method of treatment of the subject-matter of the book. Prof. Findlay, it will be observed, carried his hearers, and will carry his readers, far beyond the stock subjects of ordinary lecturers on the utility of chemistry. He has not hesitated, in fact, to deal with some of the most recondite problems of modern science, and has given amongst his illustrations many of the most striking and characteristic achievements of the present time. In so doing he has acted wisely. He has not only added thereby to the interest and merit of his book, but he has conferred upon it a measure of permanency which it might otherwise not possess.

The work is a distinct and valuable addition to the popular literature of science, and it is well worthy of a place in the library of every secondary school. No more appropriate gift-book to the youthful tyro could be given, for it is admirably calculated to awaken the aspiration and quicken the enthusiasm of the boy or girl who has any latent faculty for science. Even if it does not impel them towards a scientific calling, it will at least furnish them with a stock of facts and ideas which cannot but tend to widen their intellectual horizon and enlarge their mental outlook. If books of this kind were more generally read and digested we should have less cause to complain of that apathy which has hitherto characterised even the cultured classes in this country in regard to the claim of physical science to be an essential part in the scheme of our national education.

T. E. THORPE.

ECONOMIC GEOGRAPHY.

Commerce and Industry. By Prof. J. R. Smith. Pp. viii+596. (New York: H. Holt and Co., 1916.) Price 1.40 dollars.

THIS book is for the most part an abridgment and rearrangement of the matter composing the same author's "Industrial and Commercial Geography," reviewed in NATURE of February 26, 1914 (vol. xcii., p. 707), though this fact is disguised, to some extent, by the titles given to the sections and chapters. Part i. is entitled "The United States," but the chapters are, for the most part, the same, even in title, as those which come under the general heading, "Industrial Geography," in the earlier and larger work, but with the omission or transference to another part of the book of paragraphs which do not properly come under the head of "The United States." The second part is entitled "Foreign Countries," and here comes in most of the new matter; but even here so much is made up of paragraphs derived from the source just indicated that it requires a very close comparison of the two volumes to ascertain how much altogether is new. A third part is entitled "World Commerce," and this is entirely composed of chapters abridged from the corresponding chapters of either part i. or part ii. of the "Industrial and Commercial Geography." A statistical appendix is added, containing tables transferred from the body of the earlier work, brought up to date where necessary, in addition to a few others, these latter including elaborate and useful international comparisons.

From the account just given it will be understood that though the title of the present volume does not profess to offer us a geographical text-book, the contents are even more geographical in form than those of its predecessor. Different countries, or sometimes regions, are the subjects of the chapters in the part, comprising just 200 pages, bearing the general heading "Foreign Countries." In the arrangement of these chapters, as well as in the allotment of space to the different countries, the American point of view is naturally dominant. The first six chapters are devoted to American countries outside the United States, and take up one-fourth of the space given to the whole of this part. The descriptions of countries are necessarily brief. They do not go into details of regional geography, but everywhere they show the author's well-known penetrating intelligence. They are admirable summaries from the view-point indicated in the title of the book. They provide teachers with much food for thought as to the geographical causes explaining or contributing to explain the actual state of industrial and commercial development and course of trade, as well as those which afford grounds on which to base reasonable estimates for the future. And in this respect the text is well supplemented by illustrations (many new to this work) of striking significance.

One defect of the larger work is illustrated in this book also. The author does not seem to be a very good proof-reader. On p. 132, title of illustration, we have "countries" for "counties"; p. 476, "Cerea" for "Ceará"; p. 480, "Massamedes" for "Mossamedes"; p. 482, "Beiro" for "Beira." In the last table of the book, a reproduction of that given on p. 100 of the earlier work, the obvious mistake of "1·65" for "16·5" as the percentage of protein in sirloin steak is repeated. In the legend to the wheat map of Russia on p. 400 one is obliged to ask, 1 per cent. of what?

G. G. C.

OUR BOOKSHELF.

Geodetic Surveying. By Prof. Edward R. Cary. Pp. ix+279. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10s. 6d. net.

UNDER the title of "Geodetic Surveying" this book deals with the determination of positions of points with the aid of which topographical surveys can be controlled and combined to form a consistent whole. The methods described are those which have been developed by the Coast and Geodetic Survey of the United States, and their publication in the present work provides a convenient

summary of much that has been published in the reports of the survey.

Primary, secondary, and tertiary triangulations are included, the permissible triangular error in the first of these being put at 3″ and that of tertiary triangulations at 15″. The measurement of base lines is fully described, and examples are given to show how various sources of error are eliminated. Invar tapes of 50-metres length are used exclusively for base measurement in all grades of work, and a precision of 1 in 2 million is found to be attainable. The cost of such measurements is given as 20*l.* per kilometre on the average, rising to 30*l.* in some cases. The tape is usually supported in the centre and at each end, but in windy weather two additional intermediate supports are advantageously employed. The observation of horizontal angles is fully dealt with, and the reduction of the results is explained and illustrated by well-selected examples. A short chapter deals with the subject of map projections, and as this branch of the subject had to be so superficially dealt with, references to works which treat of it more completely might with advantage have been added.

Two appendices are devoted to the determination of time, longitude, latitude, and azimuth, and to the method of least squares as required by the surveyor. The whole forms a very useful and convenient manual of advanced surveying based on American requirements, but it will be welcomed also by surveyors in British colonies, where much work of this character has still to be done, as it will suggest methods which may suit the cases there occurring. H. G. L.

The Birds of Britain: Their Distribution and Habits. By A. H. Evans. Pp. xii+275. (Cambridge: At the University Press, 1916.) Price 4*s.* net.

MR. EVANS's name is a sufficient guarantee of accuracy, and this little volume, intended primarily for schools, calls for no adverse criticism. The considerable advances in our knowledge of British birds which have been won and "consolidated" during the last twenty years or so have all been taken account of, with due caution as to the present tendency to discover innumerable local forms and to recognise plenty of sub-species. In point of method Mr. Evans adopts a new plan; he deals with the birds according to their families, giving a separate section to each family, but not to each species. In this way the learner gets a better idea of the British bird-world as a whole, and of the several departments of it, than he could have done from the older books, where the interest was concentrated on the individual species. No doubt those older books, with their pleasant talks about the ways of a species, will always be both welcome and necessary; but this one has a value of its own, and is at the present moment the only cheap handbook which is fully up to date. The illustrations are the least attractive part of it, and much space might have been saved for the letterpress by the omission of some photographs by which nothing seems to be gained.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

On Fizeau's Experiment.

IN two papers published in the Proceedings of the Amsterdam Academy (vol. xvii., 445, 1914; vol. xviii., 398, 1915) an experimental investigation concerning Fresnel's convection-coefficient for light of various colours was described. The main object of my repetition of Fizeau's experiment, in the improved form introduced by Michelson, was to decide between the expressions for the convection-coefficient given by Fresnel and by Lorentz. As a review of the papers mentioned has appeared in NATURE (vol. xcvi., 430, 1915), I may be permitted to give here a short account of further progress. It may suffice to recall that my results were largely in favour of the Lorentz expression with the dispersion term. For the wave-length 4500 Å.U. the difference between the two expressions under consideration amounted for water to quite 5 per cent. The probable error of the experimental result was estimated at somewhat less than 1 per cent.

The weak point of my investigation is the determination of the velocity of the running water at the axis of the tubes. This velocity was deduced from the mean velocity combined with the ratio of the mean velocity to the velocity at the axis. The most trustworthy measurements available at the time gave for this ratio 0·84, and this number was adopted. A direct measurement of the velocity at the axis would have been preferable, but only lately have I succeeded in devising an (optical) method for this purpose. Small gas bubbles introduced into the running water are illuminated by a very intense, narrow beam along the axis of the tube. A small window in the wall of the tube permits the inspection of the brilliant bubbles in a rotating mirror. From the inclination of the paths of the bubbles, as seen in the mirror, and the constants of the apparatus, the velocity is deduced at once. Direct tests proved the trustworthiness of the optical method.

Applying this method (Amsterdam Proc., vol. xviii., 1240, 1916) to my original apparatus, the window being at the prism end of the arrangement, unexpected results were obtained. The velocity actually observed by the optical method not only differed from the formerly accepted value of the velocity at the axis by several per cent., but by reversing the flow of water its value (at the same window) appeared to change by quite 10 per cent. Nothing short of a measurement of the velocity at a number of points of the tubes and for both directions of the water current became necessary. For this purpose a Pitot tube, *verified by the optical method*, was made use of. The results were further confirmed by the determination of the velocity distribution over the cross-section of the tubes at a few places. Evidently one cannot speak of *the* velocity at the axis, as its value changes in a rather complicated manner along the tube. A detailed description will be published shortly in the Proceedings of the Amsterdam Academy. The average mean value of the velocity at the axis comes out 550·8 cm./sec. This is only ½ per cent smaller than the value accepted in my principal paper. The conclusions there given remain unchanged, but they are now arrived at very directly, all verification of water-meters and the determination of the ratio

of mean velocity to velocity at the axis being avoided. The formula for the displacement of the interference fringes must henceforth be written with a factor $\int_0^l v_{\max} . dl$, instead of the simple product $v_{\max} . l$. Finally, the value of the ratio of the mean velocity to the velocity at the axis may now be calculated. We obtain 0·844. This number is not, however, a physical constant, but a constant of my apparatus.

Only quite recently have I become acquainted with the extremely important and exhaustive work done at the National Physical Laboratory, published by Drs. Stanton and Pannell in their memoir on similarity of motion in relation to the surface friction of fluids. From their data I find for the often mentioned ratio 0·82, when the values of maximum velocity and diameter of the tubes in my case are substituted. Their observations were made, however, after the passage of a length of pipe varying from 90 to 140 diameters, sufficient to enable any irregularities in the distribution of the velocities to die away. In my repetition of Fizeau's experiment this condition was, of course, largely departed from, so that there is no conflict between the results.

Amsterdam, August. P. ZEEMAN.

THE NEWCASTLE MEETING OF THE BRITISH ASSOCIATION.

JUDGING by the number of members who have already intimated their intention to be present at the meeting of the British Association in Newcastle-upon-Tyne, which, as previously announced, will open on Tuesday, September 5, and close on Saturday, September 9, and taking into account the numbers who have enrolled locally, an attendance of about 1200 is expected. The intention is to hold a purely business meeting—a meeting in keeping with Newcastle in particular and the world in general.

The general title of the President's address, which Sir Arthur Evans will deliver in the Town Hall on the Tuesday evening, is "The Cradle of European Civilisation."

The work of the sections will commence on the Wednesday morning, and so far as can be ascertained at present the following are the programmes:—

Section A (Mathematics and Physical Science). The title of Prof. Whitehead's address to Section A is "The Organisation of Thought." The address is a brief examination of the nature of scientific thought. The crude immediate experience of Nature is contrasted with the refined scientific conceptions and with the exact deductions of applied mathematics. The problem considered is, "How do these two sides of scientific knowledge fit together?" Two discussions have been arranged, one on gravitation, to be opened by Mr. E. Cunningham, and the other on osmotic pressure, to be opened by Prof. A. W. Porter. Papers to be read are:—"The Partition of Numbers," by Major P. A. MacMahon; "The Measurement of Time," by Prof. H. H. Turner; "X-Ray Spectra of the Elements," by Sir E. Rutherford.

On the Friday of the meeting the section will divide into departments of (*a*) General Physics, (*b*) Cosmical Physics, and (*c*) Mathematics. In (*a*) Prof. W. M. Hicks will deal with "Can the Frequencies of Spectral Lines be represented as a Function of their Order?" Dr. R. T. Beatty is to read a paper on "Measurement of the Energy in Spectral Lines"; Prof. J. C. McLennan on "Ionisation Potential"; and Dr. S. Chapman on "The Kinetic Theory of Gases." Communications to Department (*b*) are "Efficiency of Sun-spots in relation to Terrestrial Magnetic Phenomena," by the Rev. A. L. Cortie; and the Report of the Seismology Committee. Department (*c*) is to consider:—"Oscillating Asymptotic Series," by Prof. G. N. Watson; "Suggestions for the Practical Treatment of the Standard Cubic Equation," by Prof. R. W. Genese; and "On a New Method for the Solution of Quartic Equations," by Mr. P. Burton. By way of explanation of the section devoting its main attention to problems which may seem remote from those especially in the nation's thoughts at the present time, it is explained that much of the work now being done by members of the section is of a confidential nature, and that it is considered undesirable to discuss such subjects as, say, aviation or optical problems, on which it would be impossible to speak freely without indiscretion.

In the presidential address to Section B (Chemistry), Prof. G. G. Henderson proposes to give a short account of the chief developments in chemical technology during the last quarter of a century, and then to deal with the future prospects of the chemical industry in this country. The papers to be read before Section B are:—"The Future of the Organic Chemical Industry," by Mr. F. H. Carr; "The British Coal-tar Colour Industry in Peace and War," by Mr. C. M. Whittaker; "The Preparation of Chemicals for Laboratory Use," by Mr. W. Rintoul; several short papers on iron and steel problems by Dr. J. E. Stead; and "On the Stepped Ignition of Gases," by Prof. W. M. Thornton. There will be joint discussions with Sections A, C, and G.

In Section C (Geology) there will be papers read on "Local Geology," by Prof. G. A. Lebour; "The Old Red Sandstone Rocks of Kiltorcan, Ireland," by Prof. T. Johnson; "Description of a Plexographic Model of the South Staffordshire Thick Coal," by Mr. W. Wixham King; "The Acid Rocks of Iceland," by Mr. Leonard Hawkes; "The Petrology of the Arran Pilchstones," by Dr. Alexander Scott; "The Carboniferous Succession in North Cumberland," by Prof. E. J. Garwood; "The Permian of North England," by Dr. D. Woolacott; "Geological Characters of Glass Sands," by Dr. P. G. H. Boswell; and "Some Geological Aspects of Moulding Sands," by Dr. Boswell. There is to be a joint meeting with Section B on "Coal and Coal Seams, with Special Reference to their Economic Uses." The section will also hold joint meetings with Section E and Section K.

Prof. MacBride's address to Section D (Zoology) will take the form of a review of our progress during the last twenty years in elucidat-

ing the laws governing the development of the germ into the adult animal. Some of the lantern-slides to be shown will illustrate the results already obtained by Prof. MacBride in the salt-water tanks in the Imperial College of Science, where for some years he has been perfecting his arrangements for rearing marine animals. The papers to be read before the section are:—"Bitharzia," by Dr. R. T. Leiper; "Further Materials for a Graphic History of Comparative Anatomy," by Prof. F. J. Cole; "Some Points of Bionomic Interest observed during the Visit of the British Association to Australia," by Dr. F. A. Dixey; "The Exploitation of British In-shore Fisheries," by Prof. W. A. Herdman; "The Coastal Fisheries of Northumberland," by Prof. A. Meek; "The Further Development of Shell Fisheries," by Dr. James Johnstone; "The Scheme of Mussel Purification of the Conway Fishery," by Dr. A. T. Masterman; "The Scales of Fishes and their Value as an Aid to Investigation," by Prof. A. Meek; "Some Notes on the Determination of the Age of Fishes by their Scales," by Dr. A. T. Masterman; "Review of the Fluctuations of the Herring, Mackerel, and Pilchard Fisheries off the South-west Coasts in the Light of Seasonal Variations of Hydrographical Factors," by Dr. E. C. Jee. On Friday morning four papers are to be dealt with, viz. "Amœbæ in Relation to Disease," by Dr. Pixewell-Goodrich; "Notes on the Amœbæ from the Human Mouth," by Dr. T. Goodey; "The Flagellate Protozoa associated with Diarrhœa and Dysentery," by Dr. Annie Porter; "War and Eugenics," by Mr. Hugh Richardson. In the afternoon of Friday the section will visit the Dove Marine Laboratory at Cullercoats.

In Section E (Geography) there is to be a discussion on political frontiers, to be opened by Sir T. H. Holdich, and the following papers are to be dealt with:—"France—a Regional Interpretation," by Mr. H. J. Fleure; "Generalisations in Human Geography," by Mr. G. G. Chisholm; "The Weddell Sea," by Dr. W. S. Bruce; "The Adriatic Problem," by Dr. R. W. Seton-Watson; "Salonica: Its Geographical Relation to the Interior," by Mr. H. C. Woods; "Recent Exploration in the Japanese Alps," by the Rev. Walter Weston; "Nepal, the Home of the Gurkha," by Mr. A. Trevor-Battye. The section on the Friday will hold joint meetings with Sections C and E.

The general title of Prof. Kirkaldy's address to Section F (Economics and Statistics) is "Thoughts on Reconstruction after the War." He will refer to the economic condition and industrial changes resulting from the war, and then attempt a forecast of the industrial future and make some suggestions as to how we may prepare ourselves industrially to meet the changed conditions at home and abroad. The section will give the greater part of the time to the consideration and discussion of the reports of the investigations which have been going forward during the year. These subjects were reported upon last year at Manchester, and were felt to be of such importance that all the investigations were continued. The first three reports, "Industrial Harmony," "Outlets for Labour," and "The Effect of the War on Credit, Currency, and Finance," are being published in one volume, and will be a continuation of last year's volume on "Credit, Industry, and the War." The papers to be read before Section F are:—"Land Settlement," by Mr. Christopher Turner; and "The English Historical Method in Economics—Rent," by Mr. T. B. Browning.

It is understood that Mr Gerald Stoney, in his address to Section G (Engineering), will deal with various subjects of vital importance at the present moment. The section will hold a joint meeting with Section B (Chemistry) and consider the subject of "Fuel Economy." The papers to be read are:—"Standardisation and its Influence on the Engineering Industries" (with a foreword by Sir John Wolfe Barry), by Mr. C. le Maistre; "The Calculation of the Capacity of Aerials, including the Effects of Masts and Buildings," by Prof. G. W. O. Howe; "The Influence of Pressure on Ignition," by Prof. W. M. Thornton; "Some Characteristic Curves for a Poulsen Arc Generator," by Mr. N. W. McLachlan; "Pressure Oil Film Lubrication," by Mr. H. T. Newbigin. The section will also receive the reports of the committees on Complex Stress Distribution, Engineering Problems affecting the Future Prosperity of the Country, and Gaseous Explosions.

In Section H (Anthropology) Dr. R. R. Marett will devote his presidential address to the subject of "Anthropology and University Education," in the course of which he will supplement the address delivered to the section in 1913 by Sir Richard Temple on the need, from an imperial point of view, of an applied anthropology. Dr. F. B. Jevons will deal with the disputed question of the exact boundary in primitive culture between practices regarded as religious and liturgical and those considered to belong to the domain of magic and sorcery. Prof. Ridgeway will explain the origin of the actor, with probably special reference to pre-classical times in Greece and the neighbourhood. Prof. Keith will discuss the question of whether the British facial type is not changing. There will be a description given by Mr. and Mrs. Scoresby Routledge of the expedition to Easter Island in the Pacific, with the latest explanation of the mysterious stone statues on that island, which has been inhabited by Polynesians, who elsewhere have been workers and carvers in wood rather than stone. It is believed that this expedition may have solved the mystery. Papers will be read on the Roman wall by Prof. Haverfield, and on Early Christian monuments in Northumbria by Mr. Collingwood. On the Friday there will be a discussion on the cultures of New Guinea and the New Hebrides, and a paper, by Prof. Sollas, on a sub-crag flint implement. Dr. Marett will narrate the story of recent archæological discoveries in the Channel Islands. Dr. Fraser will continue the account of the excavations in artificial islands in the lochs of the

Scottish Highlands. Miss Czaplicka will relate her experiences during a winter and a summer spent among the tribes of Arctic Siberia, a paper which, illustrated by a unique series of lantern slides, will throw much light on the culture and beliefs of the Tungus and other tribes, and, in a second communication, will deal with the physical types of these tribes. Finally, Miss Freire-Marreco will deal with personal experience as an element in folk tales.

In Section I (Physiology) Prof. A. R. Cushny will deal in his presidential address with the analysis of living matter through its reactions to poisons. He proposes to discuss how far the reaction to drugs may be utilised to test for the presence of different kinds of living matter. The papers to be considered by the section are:—"Report on Chloroform Apparatus," by Prof. A. D. Waller; "Effect of Pituitary Extract on the Secretion of Cerebro-Spinal Fluid," by Prof. W. D. Halliburton; "Arginine and Creatine Formation (Further Investigations)," by Prof. W. H. Thompson; "The Properties required in Solutions for Intravenous Injection," by Prof. W. M. Bayliss; "The Secretion of Urea and Sugar by the Kidney," by Prof. P. T. Herring; "The Effect of Thyroid-feeding on the Pancreas," by Dr. Kojima. There will also be a discussion upon the action of poison gases, inaugurated by Sir Edward Schäfer.

The subject of Dr. A. B. Rendle's presidential address to Section K (Botany) is unusual in that it will deal with the application of botanical work to economic uses. It is believed that the circumstances, especially the conditions which will obtain after the war, call for an effort on the part of the botanist to meet problems which will then be pressing. The papers to be read before the section include:—"Leaf Architecture," by Prof. F. O. Bower; "The Botanical Study of Coal," by Dr. Marie Stopes; "On *Rhynia gwynne-vaughanii*," by Dr. R. Kidston and Prof. W. H. Lang; "Are Endemics the Oldest or the Youngest Species in a Country?" by Dr. J. C. Willis; "Geographical Distribution of the Composite," by Mr. J. Small; "Survey Work near Bellingham," by Miss Charlotte Measham; "On the Distribution of Starch in the Branches of Trees and its Bearing on the Statolith Theory," by Miss T. L. Prankerd. In addition there will be a lecture by Sir J. Stirling Maxwell on "Afforestation," and a number of reports on various problems; there will also be a discussion on the collection and cultivation of drug plants.

In Section L (Educational Science) the programme will be devoted to three main topics: the position of science in secondary and higher education, the reform of the primary school, and the normal performances of school children. Papers on primary school reform will be read by Mr. J. G. Legge, Prof. T. P. Nunn, and Prof. J. A. Green, and the discussion will be opened by Mr. Crook, president of the National Union of Teachers. Next day Mr. J. Talbot will deal with science teaching in public and grammar schools, and will be followed by the Rev. H. B. Gray on "The Relative Value of Literary and Scientific Subjects in a Course of General Education"; Principal Hadow on "Science Teaching in the Universities"; and Dr. E. F. Armstrong on "The Value of Science in Industrial Works." On the subject of "The Place of Science in the Education of Girls" Miss M. E. Marsden and Dr. Mary H. Williams will read papers. At the meeting on the Friday, held jointly with the Psychological Sub-Section, Prof. J. A. Green and Mr. C. L. Burt are to open a discussion on "Normal Performances of School Children at Different Ages."

In Section M (Agriculture) the presidential address to be given by Dr. E. J. Russell will be a discussion of the methods by which crop production can be increased. The following papers will be read:—"British Forestry, Past and Future," by Prof. W. Somerville; "The Utilisation of Forest Waste by Distillation," by Mr. S. H. Collins; "Soil Protozoa and Soil Bacteria," by Mr. T. Goodey; "Climate and Tillage," by Mr. T. Wibberley; "Economy in Beef Production," by Prof. T. B. Wood and Mr. K. J. J. Mackenzie; "The Relation of Manuring and Cropping to Economy in Meat Production," by Prof. D. A. Gilchrist; "The Composition of British Straws," by Prof. T. B. Wood; "Losses from Manure Heaps," by Dr. E. J. Russell and Mr. E. H. Richards; "The Fixation of Nitrogen," by Mr. E. H. Richards. There will also be a discussion on motor cultivation, and another on ensilage.

As already announced, several sections are arranging excursions. In this connection it may be mentioned that Section M proposes on the Tuesday to visit the Northumberland County Council Farm at Cockle Park; on the Wednesday Lord Allendale's Farm will be inspected; on the Thursday the woods near Lintz Green will be visited, where H.M. Woods and Forests Department has a plant in operation for the distillation of waste wood; and on the Friday there will be an opportunity to inspect general types of local farming in Durham.

Section H also is arranging to meet the Cumberland and Westmorland Archæological Society on the Thursday and visit the Roman wall. Papers relevant to this visit are to be read by Prof. Haverfield and Mr. Collingwood on the evening of Wednesday, September 6. In view of the local interest and the fact that leading archæologists, including the President, are to take part, it is proposed that the meeting be held in the Lecture Theatre of the Literary and Philosophical Society.

Another engagement for the Wednesday evening is that of an informal reception and conversazione, which will be held in the Laing Art Gallery and Museum. The Right Hon. the Lord Mayor of Newcastle has very kindly consented to welcome the guests. Not only will this function provide a common meeting-ground for the members, but it will also give them an opportunity of viewing the special loan collections which have been formed by the Laing Art Gallery Committee in connection with the Association's visit.

SCHOLARSHIPS AND THEIR RELATION TO HIGHER EDUCATION.[1]

THE Board of Education has recently issued an interim report from the Consultative Committee on the reference made to the Committee early in 1913. The inquiry was interrupted by the war, but its resumption a few months later has furnished material for the present document, which contains a discussion of many subjects deserving attention by men of affairs no less than by teachers and professional educationists. The original reference was as follows:—

To consider the existing provision of awards—whether by local education authorities, by the governing bodies of secondary schools, universities, and colleges, by the trustees of endowments or otherwise—for assisting pupils (other than those who have declared their intention to become teachers in State-aided schools) to proceed from secondary schools to universities or other places of higher education; and to report how far such provision is adequate in character, extent, and distribution, and effective in meeting educational needs, and what measures are necessary and practicable for developing a system of such scholarships and exhibitions in organic relation to a system of national education.

This is a fairly wide reference, and since it is true, as observed in the report, that "no educational problem of any magnitude can be isolated," it seems obvious that the whole ground cannot be covered in an interim report. The Committee, therefore, has confined its attention to the needs of industry and commerce in connection with scholarships to be held at universities and other places of higher education. The sub-committee charged with the investigation sat on fourteen days and examined twenty-nine witnesses.

The main object of the scholarship system, which is almost peculiar to this country, is to assist the student who has shown promise and is at the same time in need of pecuniary help. Properly administered, it may be expected to afford encouragement to learning and to assist in the provision of useful public servants. But, however obvious it may be to the majority of the public that such a system is desirable, the expenditure of larger sums of money on its further extension has not been without opponents. The late Sir William Ramsay, for example, was one of those who thought it advisable to subsidise teachers and teaching institutions with the object of increasing efficiency and reducing fees, rather than to add to the pecuniary resources of the student. This was probably in part connected with his known objection to examinations, and recalls to mind one of the chief difficulties connected with any scholarship scheme—namely, the problem, at present unsolved, as to the best mode of selection.

This question naturally receives considerable attention from the Committee, and alternative methods of award are discussed in connection with scholarships from secondary schools to universities. The Committee is there led to the conclusion that no practicable method of award can be suggested which does not mainly depend on competitive examination. But in the succeeding paragraphs it proceeds to consider the importance of the adjuncts to examination derived from the school record and the opinion of teachers, the *vivâ-voce* examination of selected candidates, and in the case of science candidates the attested laboratory note-books, since laboratory examinations admit a large element of luck. But when all precautions have been observed, the marks gained in an examination must be chiefly given for *knowledge* already acquired, and most examiners of experience would admit the great difficulty of estimating justly the *capacity* of candidates to deal with unfamiliar problems and the probability of their success in research.

In this connection it is well to look with special attention, not only at the best candidates, but here and there at some of the worst. It is unnecessary to quote here the famous cases of men who have risen to eminence after an unsatisfactory career at school. The boy supposed to be dull is sometimes merely not interested in the conventional school subjects, and lives in a world of his own. There are probably few of this kind among candidates for scholarships, but there should be a constant look-out for them on the part of the schoolmaster and some means devised for giving help and encouragement if needed.

The report before us raises in the mind of the reader a great many questions besides those connected with the creation, award, and distribution of scholarships. It leaves, for example, the old confusion between education and instruction uncorrected, or rather, if possible, further beclouded. It discusses briefly but suggestively the demand for what is called equal opportunity. It points out that it is impossible, and undesirable to attempt, to give higher education to all, and it justly points out that

the public interests demand that none shall waste his time and the time of others by schooling or training at the public expense unless he or she has proved that such training is likely to be advantageous. . . . It will be economical to give more training to the highest talent and less to the inferior or mediocre.

Then, again, it appears that there are persons among the witnesses before the Committee who are prepared to find in the "public schools" the great impediment to educational progress. It is therefore well that the Committee should remind such persons, in the words of the report, that

the public schools have a great tradition; a tradition of character, a tradition of manners, a tradition of physical excellence, a tradition of self-government. They do, in fact, supply the boys of the country with more than half the higher secondary education that they receive. It would be wasteful to weaken their vigour and independence.

The Committee itself goes so far as to express the opinion that "it is desirable in the national interest that after the war the public schools should devote more energy to scientific and prac-

[1] Interim Report of the Consultative Committee on Scholarships or Higher Education. [Cd. 8291.] (London: Wyman and Sons Ltd. 1916. Price 4½*d*.

tical training." This, however, must not be taken to mean technical instruction in applied science, or the position of physical and natural science as an integral part of a truly liberal education will be seriously imperilled. How far the old universities themselves should be encouraged to deal with the technological aspects of science is an open question. The report states that "the subjects for which either Oxford or Cambridge, or both, may be regarded as offering special advantages are: Classics, history, mathematics, pure science. The modern universities should be better, as a rule, for students desirous to pursue commerce, applied science, technology." All this has its bearing on the source, the pecuniary value, and the tenure of scholarships to be held in the universities.

The Government has already appointed a Committee of the Privy Council for Scientific and Industrial Research and an Advisory Council to survey the field and propose schemes to this committee. In connection with research, the importance of continuing scholarships for a fourth or fifth year is indicated in the report. After the rather obvious remark that "the good researcher is rare," reference is made to the qualifications of women in this direction. "One of our witnesses," it is said, "has spoken unfavourably of women as researchers, at any rate in chemistry; but in our opinion experience does not point to any such general conclusion. Judgment should come later, after a full trial of feminine capacity in this direction." With this sentiment we heartily agree, notwithstanding the impression that the experience of teachers of chemistry and physics up to the present generally supports the view of the witness referred to. The independent research accomplished by women, to judge by published work, has been chiefly in connection with biological subjects.

The Committee has drawn up a series of General Conclusions, followed by a number of definite Recommendations. Among the general conclusions the report contains the following passages, with which most readers will agree:—

> The system of scholarships at every grade of education should be judged from the point of view of national needs. . . . The exceptional needs of the nation are at the present moment, and will be for some time to come, rather on the scientific and technological side than on the literary side. . . .
>
> The first need is the wider recognition, especially by employers, of the benefits that can be obtained by the employment in industry, agriculture, and commerce of men trained in science—in all grades, but especially for directive and advisory posts.
>
> Secondly, the most useful thing that can be done without any great increase in the means at our disposal is to encourage research in existing institutions after graduation. The prolongation of scholarships in suitable cases is one means that is available; other means fall within the province of the Committee of the Privy Council.

Improved and extended places of higher technical and scientific instruction as well as improved secondary education are needed, and as the universities, colleges, and schools are strengthened and the number of workers increases, so an increase in the supply of scholarships will become necessary. It appears to be admitted on all sides that we must be prepared after the war for a great increase in the cost of education in all departments. The Committee makes an estimate of the cost of the additional scholarships and other forms of endowment recommended in the report. The amount of their estimate, 339,500*l.* a year, cannot be regarded as excessive, but it will probably be prudent to begin with moderation and to be satisfied with additional endowments in proportion as the expense seems to be justified by experience.

The recommendations of the Committee are as follows:—

> We recommend for the consideration of the Board of Education, and of those local education authorities which have power to grant scholarships from secondary schools to universities and other places of higher education, and of other authorities so far as they may be concerned:—
>
> *General Principles.*
>
> (1) That, in framing schemes for scholarships, the following ends be kept in view: the training of men and women according to their capacity that they may serve the needs of the nation in the manner for which they are best fitted; the reward of merit and the encouragement of learning; and the provision of equal educational opportunity: the furtherance of industry, agriculture, and commerce being regarded as a principal need of the nation, and higher education being regarded as a means to this end among others.
>
> (2) That, for the furtherance of higher scientific and technological education, scholarships from secondary schools to universities and the highest scientific and technical colleges be still accepted as the principal means.
>
> (3) Nevertheless that, as supplementary and subsidiary means to the same end, scholarships from secondary schools to senior technical schools and technical colleges, from senior technical schools to universities and other places of higher education, from evening classes and works-schools to technical colleges and universities, be also granted on a suitable scale.
>
> (4) That a certain proportion of scholarships to places of higher education should be granted to candidates who show merit under scientific and mathematical tests alone, without any test of general education beyond an examination in the English language.
>
> (5) That the matriculation tests at the universities be modified so as to admit to full university privileges scholars who, having obtained their training by part-time or discontinuous instruction, have been selected by the tests indicated in recommendation (4), and are able to satisfy the university authorities that they are fit to take advantage of university instruction in science or technology.
>
> *Aid Required from Government.*
>
> (6) In proportion as the provision of higher secondary education is extended, improved, and used, the provision of scholarships by local authorities to universities will need to be correspondingly increased.
>
> The provision of such scholarships for women needs immediate increase.
>
> But, in order to hasten the extension of higher secondary education—especially for boys—we venture to suggest that a substantial grant-in-aid be made at

the earliest opportunity for strengthening the higher parts of selected secondary schools, or that some similar expedient be adopted for the same purpose. For this purpose we suggest as a beginning the sum of 100,000*l.* a year.

We recommend :—

(7) That the State provide maintenance grants to enable selected scholars to continue their secondary education from the age of sixteen to that of eighteen or nineteen. For this purpose we consider that 90,000*l.* would be required in the third year.

(8) That the State provide about 250 scholarships every year for students from secondary schools who intend to pursue scientific or technical subjects at the universities. That these scholarships be allotted to the several universities and awarded by the universities. We estimate the cost of this provision at the annual sum of 67,500*l.* Should the second alternative recommendation in (26) below be adopted, a further sum of about 10,000*l.* would be needed for the additional cost of such of these scholarships as may be held at Oxford or Cambridge.

(9) To encourage local authorities to develop their schemes of scholarships from secondary schools to the universities, and with special reference to increased provision of scholarships for women, we recommend that a special grant-in-aid of 25,000*l.* be made.

(10) For scholarships to the universities from senior technical schools, and for candidates who have obtained part-time instruction in scientific and technical subjects while pursuing their vocation, we recommend for the present that the annual sum of 27,000*l.* be granted.

We recommend :—

(11) That, on the application of a scholar and on the recommendation of some professor who is willing to undertake his or her training in scientific or technological research, the prolongation of a scholarship for a year after the conclusion of a degree course be favourably considered, and the cost of such a system be defrayed from national funds.

(12) That after such prolongation for one year the scholarship be capable of prolongation for another year on the certificate of the professor that the scholar shows aptitude for research, and is willing to pursue research under his guidance in some specified branch of science or technology, the cost being met from national funds.

We consider that for the purposes of recommendations (11) and (12) the annual sum of 20,000*l.* would be sufficient at the inception, and we recommend that in so far as these prolongations are defrayed from national funds the regulation of such prolongations be entrusted to a Central Committee nominated by the Board of Education.

Value of Scholarships to Universities.

We recommend :—

(13) That the value of a scholarship to a university granted by the Government or by a local authority be 60*l.*, and that all university fees and dues be defrayed in addition by the Government or the authority, except in the case of scholars who also hold a scholarship at Oxford or Cambridge or some other emolument.

(14) That the sum payable annually by virtue of the scholarship be withheld or reduced if the Government or the local authority be satisfied that the scholar or his parents or his guardians can themselves afford to defray the whole cost, or part of the cost, of his university education.

Duration of Scholarships.

(15) That the normal duration of a scholarship to a university be three years, subject to residence, good conduct, and satisfactory reports on the scholar's work.

(16) That (subject to the same conditions) the scholarship be prolonged for one year when the normal university course for that scholar is four years.

(17) That a scholarship to the university once awarded by a local education authority should not be dependent on the continued residence of the holder or his parents or guardians in the area of the awarding authority.

Methods of Award of Scholarships to Universities.

(18) That every local authority offering scholarships from secondary schools tenable at a university entrust to some university the award of such scholarships. That Government scholarships be allotted to the several universities and be similarly awarded.

(19) That such award be made accordmg to the responsible judgment of a board of about five awarding examiners, after consideration of the marks allotted and the reports made by the examiners in the several subjects, after interviewing selected candidates, after such further scrutiny of the written work as may seem to the board desirable, and after weighing in cases of doubt such further evidence as may be made admissible by the regulations.

(20) That evidence of general education up to an adequate standard be required as a qualification for appointment to scholarships from secondary schools to universities.

(21) That a serious test in English be imposed on all candidates in such competitions, and be taken into account in the award of scholarships.

(22) That subjects be grouped for purposes of examination according to some reasonable principle so as to discourage excessive specialisation on the one hand, and heterogeneous study on the other.

(23) That the examination be designed to encourage an adequate breadth of study, but that nevertheless the boards of examiners have full discretion to recognise either exceptional merit and promise in one subject, or general excellence over a wider range, as they think fit.

(24) That, in view of the special need of encouragement for scientific and technological studies, scholarships be awarded somewhat more readily to candidates who intend to pursue such studies than to others.

(25) That no examination for scholarships from secondary schools to universities be regarded as satisfactory in which more than two hundred candidates are examined in one batch.

(26) We recommend to the attention of the local authorities the practice of the London County Council in awarding senior scholarships without further written examination to those who have won open scholarships by the award of the colleges of Oxford and Cambridge; and to the colleges of Oxford and Cambridge we recommend that they should seek powers to grant a proportion of scholarships on their own foundations to such Government or county scholars as, having received the grant of a scholarship by the award of a board of examiners acting for some university, have (without further examination) proved to the satisfaction of the college that they would benefit by education at Oxford or Cambridge.

Or, as an alternative, that all scholarships to Oxford and Cambridge, whether granted by the Government or by a local authority, or by a college so far as college statutes permit, shall be of such value as to cover all strictly necessary expenses of residence, maintenance while residing, and education, subject to the provisions of recommendation (14) above.

PROF. W. ESSON, F.R.S.

IN William Esson, Savilian professor of geometry since 1897, Oxford loses one who has done much for it. A Scot whose family came South in his boyhood, there was the air of a viking about him, and few who looked upon his magnificent beard during most of the sixty-one years of his university life were not conscious of a radiation of vigour as from the North. Born at Dundee in 1838, he was educated first at Inverness, and then at Cheltenham Grammar School. In 1855 he became Bible clerk of St. John's College, Oxford. Here he obtained two second classes (1856, 1858) in classics, and in mathematics carried all before him, gaining first classes in 1856 and 1859, and the junior and senior mathematical scholarships in 1857 and 1860. In 1860 he became Fellow of Merton and mathematical tutor. He was also tutor or lecturer for various periods at Magdalen, Corpus, Worcester, and Hertford. Enormous as have been his services to Merton and to the university as financier and man of business, and real as have been his achievements in geometrical and mathematico-chemical investigation, the writer and others put first his leadership in college mathematical teaching. In the 'sixties and 'seventies there were two classes of mathematical students in Oxford—those who blessed the Providence which had put them under him, and those who envied the others.

When Prof. Sylvester's health began to fail in 1894 Esson became deputy Savilian professor of geometry, and after three years he succeeded Sylvester in the chair. He lectured most on the comparison of synthetic and analytic methods in geometry. With such subjects his not very numerous publications in pure mathematics have been concerned. They are above all things incisive. Probably he was prouder of his only semi-mathematical work on chemical—or, as he was always very careful to say, *chymical*—change. This was done largely in concert with Mr. A. G. Vernon Harcourt, and expounded in the Philosophical Transactions for 1864, 1866, and 1895. The work secured him the Fellowship of the Royal Society as early as 1869. Among the little jokes in which he delighted was one that in 1897 the Savilian professorship of *geometry* passed from a poet to a *chymist*.

Though as professor he became Fellow of New College, he was bursar of Merton till he died. For very many years he served the university as a curator of the university chest; and here his loss will be keenly felt. His great administrative powers were used for the good of the university in matters directly associated with university studies, and not in finance only. For about fifteen years, ending in 1913, he was chairman of the Board of the Faculty of Natural Science. He was a visitor (and secretary) of the university observatory.

Until a few months ago his natural force seemed in no wise abated. But his last surviving son went down with H.M.S. *Russell*, and his strength then began to fail.

PROF. S. B. MCLAREN.

LIEUT. S. B. McLAREN, professor of mathematics in University College, Reading, met his death on August 14 on the Western front, where he was serving with a signalling company of the Royal Engineers.

McLaren was of Scottish parentage. A son of the late Rev. W. D. McLaren, of Melbourne, he was born in Japan, but most of his early life was spent in Australia. After a distinguished career at the University of Melbourne, he proceeded to Trinity College, Cambridge, of which he became a major scholar. He was third wrangler in 1899, gained a first class in Part II. of the Mathematical Tripos in 1900 and the Isaac Newton studentship in 1901. He continued in residence at Cambridge until 1903, when he accepted a position at Bristol University College, whence in 1906 he proceeded to Birmingham University as assistant-lecturer in mathematics. Shortly before his appointment to the professorship of mathematics in University College, Reading, he had shared with Prof. Nicholson the Adams prize at Cambridge.

The outbreak of war found McLaren in Australia with the British Association, acting as a secretary of Section A, and back with his parents and among his earlier friends. During the return voyage he was fired with an enthusiasm to offer his services to his country, and he employed his time on board in learning signalling, and on arrival joined the signalling company organised by a colleague, Major Pearson, of University College, Reading. He saw several months of active service before receiving the wound which only a few days later proved fatal. He was fearless and intrepid on the field, and carried out his duties tirelessly and with a disregard for his personal safety which was at once an inspiration to his men and the concern of his brother officers.

McLaren's published work, which was characterised by originality and a fine boldness of conception, related particularly to the mathematical treatment of the phenomena of radiation and of gravity. Shortly before he gave up his academic work he was engaged in writing upon the magneton, and he considered that he had obtained results of value. But his interest in mathematical physics is not adequately gauged by his published work. He was a diligent worker and thinker, contrary, perhaps, to the impression of the casual acquaintance, and he sought strenuously for a basis upon which to build. His interest in philosophy was part and parcel of his regard for the fundamental things. All who have been associated with him will regret the cutting short of a promising career and the loss of a simple, sincere, and genial friend.

W. G. D.

NOTES.

THE terms of reference, and the constitution, of the two committees appointed by the Prime Minister to inquire into the position of science and modern languages respectively in the system of education in Great Britain have now been announced. The membership of the committees suggests that the Govern-

ment wishes each of these subjects to be considered chiefly from the point of view of education as a whole; for the particular interests of science and modern languages are represented by a few members only. The terms of reference and constitution of the Science Committee are as follows:—To inquire into the position occupied by natural science in the educational system of Great Britain, especially in secondary schools and universities; and to advise what measures are needed to promote its study, regard being had to the requirements of a liberal education, to the advancement of pure science, and to the interests of the trades, industries, and professions which particularly depend upon applied science; Sir J. J. Thomson (chairman), the Rt. Hon. F. D. Acland, Prof. H. B. Baker, Mr. Graham Balfour, Sir William Beardmore, Bart., Sir G. H. Claughton, Bart., Mr. C. W. Crook, Miss E. R. Gwatkin, Sir Henry Hibbert, M.P., Mr. William Neagle, Mr. F. G. Ogilvie, C.B., Dr. Michael Sadler, C.B., Prof. E. H. Starling, Mr. W. W. Vaughan; secretary, Mr. F. B. Stead, H.M. Inspector of Schools. Owing to unforeseen circumstances Lord Crewe finds that it will not be possible for him to act as chairman of the committee, as previously announced.

THE terms of reference and constitution of the Modern Languages Committee appointed by the Government are as follows:—To inquire into the position occupied by the study of modern languages in the educational system of Great Britain, especially in secondary schools and universities, and to advise what measures are required to promote their study, regard being had to the requirements of a liberal education, including an appreciation of the history, literature, and civilisation of other countries, and to the interests of commerce and the public service; Mr. Stanley Leathes, C.B. (chairman), Mr. C. A. Montague Barlow, M.P., Mr. E. Bullough, the Rt. Hon. Sir Maurice de Bunsen, Mr. A. G. Coffin, Dr. H. A. L. Fisher, Mr. H. C. Gooch, Mr. J. W. Headlam, Mr. L. D. Holt, Dr. Walter Leaf, Dr. G. Macdonald, Mr. A. Mansbridge, Mr. Nowell Smith, Miss M. J. Tuke, Sir James Yoxall, M.P.; secretary, Mr. A. E. Twentyman. In considering the provision of scholarships, bursaries, etc., the committees are requested to take into account the interim report of the consultative committee of the Board of Education on this subject.

LORD MONTAGU OF BEAULIEU, in a speech at Bury St. Edmunds on August 23, gave some interesting particulars of Germany's new super-Zeppelins. These are said to have a capacity of 2,000,000 cubic ft., giving a total lift of about 60 tons. Their length is 780 ft., speed 65 miles per hour, and the engines develop more than 1500 horse-power. (The original figure given was 15,000, but this was an error, and has since been corrected.) These figures are a little surprising, but there seems to be no reason why such an airship should not be satisfactorily designed, especially after the experience which Germany has had with the older types. It would appear that these super-Zeppelins are intended for offensive operations, rather than as scouts for the fleet, for which latter purpose the existing types are of sufficient capacity. If this is the case, our anti-aircraft defences will need to be as efficient as we can make them. Raids by means of rigid airships have introduced a new problem for the gunnery experts to solve, for a Zeppelin at 10,000 ft. altitude, and moving at 60 miles an hour on a dark night, presents an exceedingly difficult target, and the small number of hits scored up to the present is not surprising. However, a great deal is being done to deal with this new situation, and it is to be hoped, as Lord Montagu said, that the super-Zeppelins will not achieve the results which our enemies seemingly anticipate.

SIR ERNEST SHACKLETON is losing no opportunity of attempting to rescue his stranded comrades on Elephant Island. Last Saturday he sailed from Punta Arenas on his fourth attempt. This time his vessel is the *Yelcho*, a small Chilian steamer which towed the *Emma* 240 miles south of Cape Horn in the last unsuccessful attempt at rescue. The *Yelcho* does not appear to be well suited for the task before her, but, failing such a ship as the *Discovery*, now on her way out, one vessel is little better or worse than another, and success or failure depends entirely on the ice conditions. In this respect there is some prospect of September proving better than July or August. If Elephant Island is clear of ice, the *Yelcho* should return to civilisation early in September with the explorers on board.

WE regret to announce the death, on August 27, at sixty-three years of age, of Dr. C. T. Clough, district geologist of H.M. Geological Survey, Scotland.

THE twenty-seventh annual general meeting of the Institution of Mining Engineers will be held at Glasgow on September 14–15. The institution medal for the year 1915–16 will be presented to Dr. W. N. Atkinson, in recognition of his investigations in connection with colliery explosions and coal-dust.

SIR CHARLES H. BEDFORD has been appointed general secretary of the newly constituted Association of British Chemical Manufacturers. The business of the association is for the present being carried on at the offices of the Society of Chemical Industry, Broadway Chambers, Westminster.

THE Toronto correspondent of the *Times* states that the Naval Service Department in Ottawa has received the following message from Dr. Anderson at Nome respecting the Stefansson expedition:—"Starkerson has reported that Stefansson is safe on north-west coast, where he was reported on May 7. The *Polar Bear, Mary Sachs*, and *North Star* are safe."

CAPT. A. R. BROWN, formerly science master at Buckhaven High Grade School, and 2nd Lieut. H. Watson, mathematical master at Ormskirk Grammar School, have both been killed in action. Capt. Brown was educated at Airdrie Academy and Glasgow University, where he graduated M.A. and B.Sc., and he was a fellow of the Royal Society of Edinburgh. 2nd Lieut. Watson was educated at Burnley Grammar School and Manchester University, where he graduated with first-class honours, obtaining his degree of B.Sc. in 1907. Before going to Ormskirk he held the position of mathematical master at the Technical Institute and Secondary School, Salford.

DURING the early hours of August 16 an earthquake was felt at Ancona, Pesaro, Rimini, and other places on the north-east coast of Italy. The shock seems to have been strongest at Rimini, where several houses were wrecked, though buildings were also damaged at Pesaro, twenty miles to the south-east. All three places lie within well-defined seismic zones, but, while the earthquakes of the Pesaro and Ancona zones are usually of a local character, those of the Rimini zone (and especially the earthquakes of 1672 and 1875) are often felt over a wide area. According to the *Times* of August 17, seven earthquakes were recorded at Shide on August 16, originating in northern Italy or in Austria.

THE autumn meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers on September 21 and 22. The following papers are expected:—"Some Properties of Ingots," H. Brear-

ley; "Influence of Heat-Treatment on the Thermoelectric Properties and Specific Resistance of Carbon Steels," Prof. E. D. Campbell; "Heat Treatment of Eutectoid Carbon Steels," Dr. H. M. Howe and A. G. Levy; "Steel Ingot Defects," J. N. Kilby; "Manganese Ores of the Bukowina, Austria," H. K. Scott; "Influence of Elements on the Properties of Steel," Dr. J. E. Stead; "Notes on (*a*) Nickel Steel Scale, (*b*) on the Reduction of Solid Nickel and Copper Oxides by Solid Iron, (*c*) on Effect of Blast-furnace Gases on Wrought Iron," Dr. J. E. Stead; "Use of Meteoric Iron by Primitive Man," G. F. Zimmer.

WE regret to notice that Sir Richard Biddulph Martin, the chairman of Martin's Bank, died on August 23, in his seventy-eighth year. Sir Richard Martin was not only an eminent banker and one of the founders of the Institute of Bankers, but also gave much time during his long and active life to the work of charitable and social undertakings, and of more than one scientific society. Of the Fishmongers' Company he was twice Prime Warden, and represented the company on the Executive Committee of the City and Guilds of London Institute. He had held the office of treasurer of the Royal Statistical Society of London since 1875, the longest period of office of any treasurer since the foundation of the society, and was elected to the presidency in 1906. He always exhibited the warmest interest in the welfare of the society, and was a regular attendant at council and ordinary meetings until increasing lameness in recent years rendered attendance almost a physical impossibility. Sir Richard was also keenly interested in the work of the Royal Anthropological Institute, of which he was a vice-president, and in that of the Royal Geographical Society.

A RECENT article by Dr. Saleeby on "Armoured Men," published in the *Daily Chronicle* of August 7, gives some particulars as to the construction of the "soup-plate" helmet with which British troops are now provided. It is really a double structure. It is first a soft cap, bounded all round its edge with thick rubber studs—now made hollow for greater resilience. This cap has a double lining of felt and wadding, so that even if the helmet be pierced at point-blank range the scalp is guarded from the steel. Upon this padded cap is poised the casque of steel. The interval between the two serves for ventilation. The steel used is that discovered some twenty years ago by Sir Robert Hadfield, and known as manganese steel. The helmet weighs 2 lb., and is said to be bullet-proof to a Webley automatic pistol at five yards' range. Every helmet now supplied to the troops is proof against a shrapnel bullet, forty-one to the pound, with a striking velocity of 750 ft. per second. To prevent the surface from acting as a mirror it is sanded and roughened. The helmet is fixed with an adjustable strap under the chin, and its rim is blunted so as to avert injury to the temples of the next men's heads in the close company of the trenches. The pitch of the helmet is made as low as possible. Dr. Saleeby finally urges that the protection of similar steel should be now applied to other vital parts of the body. It is estimated that this would cause an addition of not more than 4 lb. to the weight carried by the soldier, and that this addition could be compensated by the temporary reduction of other equipment, at least when the soldier is storming positions held by the enemy.

THOSE who are interested in iconography will welcome the paper by Prof. Flinders Petrie on "Early Forms of the Cross from Egyptian Tombs," published in part iii. of *Ancient Egypt* for 1916. The numerous examples illustrated are taken from tombs of the fourth and fifth centuries B.C. As persecution increased in Egypt there arose a tendency to disguise the forms of the symbol, so that it should be recognisable only by the initiated. Prof. Petrie disregards the so-called Tau cross, represented in some dictionaries as having come from Egypt. He says that he has never seen it represented or described there, and he does not understand why Egypt has been regarded as its source. On the other hand, he has no doubt of the Egyptian origin of early crosses found in Great Britain and Ireland, though most of these have the long form which, probably with the object of disguise, was at an early period abandoned in Egypt and replaced by that of the square shape.

PROF. M. CAULLERY's introductory "exchange" lecture at Harvard on "The Present State of the Problem of Evolution" is published in *Science* of April 21 last. He surveys broadly, in this discourse, the progress of biological speculation from the beginning of the nineteenth century, pointing out that some recent interpretations of heredity tend to bring the concept of evolution into line with the "evolutio" of pre-Lamarckian philosophers. With these interpretations Prof. Caullery admits imperfect sympathy, and promises his hearers "support of a transformism more or less Lamarckian." From this introductory lecture they may look forward to a stimulating course, and Prof. Caullery's graceful tribute to American workers in biology—from Louis and Alexander Agassiz to E. B. Wilson, Loeb, and Castle—must have been welcome to his hearers at Harvard.

ON the other hand, Dr. Chas. B. Davenport, writing in the *American Naturalist* (l., No. 596, August, 1916), on "The Form of Evolutionary Theory that Modern Genetical Research seems to Favour," expresses belief in "internal changes chiefly independent of external conditions" as furnishing the effective agency in development. He adopts Bateson's suggestion of a primitive germ-plasm with highly complex constitution, from which factors ("genes") have become split off and lost in the course of ages, thus giving rise to new forms of life. Yet Dr. Davenport does not absolutely exclude environmental influence. "There is some evidence," he admits, "although not as critical as might be wished, that the germ-plasm is not beyond the reach of modifying agents."

THE last meeting of the session of the Zoological Society of London was held on August 16, Dr. Henry Woodward being in the chair. The report laid before the meeting was most gratifying, since it showed that the number of visitors to the Gardens from January 1 to July 31 showed an increase of 14,619, as compared with the corresponding period of 1915, while the receipts during the same period showed an increase of 733*l*., as compared with the corresponding period of last year. The number of new fellows admitted also showed an increase. Among the most noteworthy additions to the society's collection during the month of July were a pair of Fennec foxes, *Vulpes zerda*. This species is the smallest existing member of the Canidæ, and is found not only all over the Sahara, but extends also into south-western Asia.

A REPORT of considerable value and interest appears in the *Meddelelser fra Kommissionen for Havundersøgelser* on "Marking Experiments with Turtles in the Danish West Indies," by Dr. Jos. Schmidt. Four species are found in this area—the leathery, loggerhead, hawksbill, and green turtles—and the author gives a brief but extremely useful summary of their breeding habits, supplemented by some excellent figures of newly hatched specimens of each species. The

leathery turtle and the loggerhead have no great commercial value, but their eggs are taken in large numbers. The green turtle, however, for its meat, and the hawksbill for the sake of its horny shields, which form the "tortoiseshell" of commerce, are subjected to a heavy toll, young and adults alike being taken. The green turtle is happily enabled to lessen the strain of this persecution in that it lays its eggs so near the margin of the sea that all traces of their whereabouts are obliterated by the wash of the tide. Since the Danish West Indies have recently been purchased by the United States it is to be hoped that stringent protective measures will speedily be devised and enforced, for it is evident that otherwise the extermination of these colonies is within measurable distance.

In a "Note on the Economic Uses of Rosha Grass, *Cymbopogon martini*, Stapf," published in the "Indian Forest Records," Mr. R. S. Pearson points out that this grass exists in two forms, known to the natives as "Motia" and "Sofia." The two forms appear to differ morphologically only in the fact that in the Motia grass the leaf blade makes a wider angle with the culm than is the case in the Sofia grass. The distribution of the two forms also differs considerably, Motia growing in isolated clumps on bare hot slopes, whilst Sofia occurs on low ridges and in shady nullahs often as a dense crop. The chief difference between the two forms lies, however, in the characters of the essential oils they contain, Motia grass yielding "palmarosa oil," containing as much as 90 per cent. of free and combined geraniol, whilst the Sofia form yields the so-called "ginger grass oil," containing only about half as much geraniol. The note states that experimental cultivation of the two forms has now been undertaken at Dehra Dun by Mr. R. S. Hole with the view of determining their botanical relationship.

THE Journal of the Society of Siberian Engineers (Tomsk, March, 1916) directs attention to the backward state of Russian agriculture in the matter of the employment of artificial fertilisers, and emphasises the vital necessity of reform in this direction. In contrast with other countries it is pointed out, among other things, that Russia does not yet possess a single factory for utilising atmospheric nitrogen in the preparation of fertilisers, though she has ample supplies of raw material and water-power.

AN interesting instance of untutored native ability is reported from Tomsk in the Journal of the Society of Siberian Engineers (January, 1916). In the Ochansky district a self-taught farm labourer, Kazymov by name, working on the model of the American machines, made a horse reaper of a very simple type, weighing only 400 lb., and capable of being worked easily by one horse. The local council, on hearing of this, considered it sufficiently important to warrant official investigation, and appointed a special committee for that purpose. After inspecting the machine the committee came to the conclusion that although of very primitive construction it is suitable for the work and might with some trifling technical alterations be widely adopted, seeing that it is superior to the factory-made machine in lightness and in suitability for the small "one horse" farmer. The price of the Kazymov reaper may be estimated approximately at 8*l*.

THE distribution of cyclonic precipitation in Japan is the subject of a paper by Messrs. Terada, Yokota, and Otuki in the Journal of the College of Science, Tokyo, vol. xxxvii, art. 4. The paper is partly a statistical investigation of the influence of land and water in modifying the rainfall from 1905 to 1915, but contains also an attempt to analyse the factors that determine the unsymmetrical distribution of precipitation. These the authors group as (1) thermal and planetary, which depend on latitude; (2) thermal and geographical, which depend on the prevalence of sea or land; (3) hydrodynamical and topographical, caused by the ascending air current. The whole discussion is somewhat hypothetical, and would be more profitable were the data more numerous.

THE eruption of Mauno Loa which took place last May is briefly described by Mr. H. O. Wood in the Weekly Bulletin of the Hawaiian Volcano Observatory (vol. iv., No. 5, 1916). Fume-columns were first noticed at 7 a.m. (or 5.30 p.m., G.M.T.) on May 19. At 8 a.m. the crown of the cloud had reached a height of not less than 20,000 ft. above the mountain profile, but by noon the rush of fumes had almost ceased. A small amount of lava was ejected at the time of this outburst. Shortly after 11 p.m. on May 21 another and greater flow began from a source lower down the slope, at an altitude of about 7000 ft. on the south-south-west slope of the mountain. Hundreds of very slight tremors were registered during these days at the Volcano Observatory on the north-eastern slope of Kilauea, though only three or four were strong enough to be felt in the neighbourhood of the observatory.

THE August number of the Proceedings of the Physical Society of London completes vol. xxviii. The seven papers included in it cover seventy pages, and are of exceptional interest. Mr. G. D. West deals with the effects of the residual gas in measurements at low gas pressures of the pressure due to radiation. Miss Humphrey and Dr. Hatschek show that the viscosity of a liquid having small solid particles in suspension increases more rapidly than the aggregate volume of the suspended matter, and depends on the rate of shear. Capt. Phillips describes a form of mercury jet interrupter by means of which he has investigated the conditions which determine the smooth working of the interrupter. Dr. P. E. Shaw and Mr. C. Hayes describe a magnetometer of the torsion balance type a million times as sensitive as any previous instrument. Dr. S. W. J. Smith discusses the relation between the original migration experiments of Hittorf and the recent ones of Mrs. Griffiths, which have given somewhat different results. Dr. Allen shows that Ratnowsky's recent theory of the process of fusion is incorrect, and Dr. Chatley describes the present position of the attempts to explain cohesion and shows that it must be regarded as the difference between the attractive and repulsive forces between molecules.

THE sixth annual report of the Road Board has just been issued. The amount of new work sanctioned has been reduced greatly, but the Board has continued to supervise the construction and maintenance of new roads required for military purposes, and this work has extended considerably. An account of the method of testing surfaces by rotary machine is included. The machine consists of a revolving frame supported on wheels running on a circular test path at any desired speed—not exceeding seven miles an hour for steel tyres. Each of the eight wheels is independently driven by electromotors. The usual load per inch width of tyre has been about 470 lb. Since wetted surfaces can be tested to destruction sooner than dry surfaces, the wet test has become the standard of comparison. A room temperature approaching that of summer has generally been maintained, since bituminous materials soften and show the least resistance to deformation during the summer months. After the test track has been laid, the

machine is started and run on the new surface with a gradually increasing load until about 4000 to 6000 tons per yard of width have rolled over it; this is called the consolidation period. The test proper is then commenced, and the machine is run at a rate of about 2200 tons per yard of width per hour. In most cases with good materials a well-laid surface remains smooth and polished until about 200,000 tons per yard of width have rolled over it. About this stage wave-like markings begin to appear; these gradually extend until at 400,000 tons the surface becomes considerably waved and the vibration is excessive. The test is then considered complete. The results of four tests with mexphalte and aztecphalte are included, and are of interest as showing that considerable difference in the durability may be caused by the method of laying and by the workmen employed.

WE have received a booklet entitled "Economical Dishes for War-time," by Miss Florence A. George (Messrs. Cornish Bros., Birmingham, price 6*d*.). It contains a number of useful recipes for the preparation of economical meat and vegetable dishes and sweets. A brief introduction deals with the food requirements of the body, and at the end some hints are given on the management of gas-stoves.

THE following books are in the press for inclusion in the "Cambridge Technical Series" of the Cambridge University Press:—"Experimental Building Science," vol. i., J. Leask Manson; "Alternating Currents," W. H. N. James; "Development of English Building Construction," C. F. Innocent; "Naval Architecture," J. E. Steele; "Chemistry and Technology of Oils and Fats," F. E. Weston and P. J. Fryer; "Physics for Engineers," J. Paley Yorke; "Chemistry of Dyeing," Dr. L. L. Lloyd and M. Fort.

OUR ASTRONOMICAL COLUMN.

BRIGHT DISPLAY OF AURORA BOREALIS ON AUGUST 27.—A fine exhibition of Aurora Borealis was observed by Mr. W. F. Denning at Bristol in the early morning of Sunday, August 27, between the hours of 2 and 4 G.M.T. Shafts of light were first observed at about 2h. 15m. ascending amongst the stars of Ursa Major and Draco, and reaching considerable altitudes. Changes affected the appearances at short intervals, the streamers would fade away and new ones form, while the invariable disposition of the whole was to move quickly from the west to the east side of the north point. Some of the more conspicuous streamers were particularly recorded as they passed over certain stars, and the mean rate of motion across Ursa Major was found to be 15° in three minutes.

The active region seemed to extend from as nearly as possible N.W. to N.E., but the N.W. and N. showed the greatest abundance of streamers; in the N.N.E. there was a succession of faint bands of light rising upwards to the left of Auriga. Many of the rays observed in the N. region could be faintly traced to altitudes of 70°. The phenomenon was watched until 3.45, when the sky had regained its normal appearance, and twilight had become strong in the north-east.

DISTRIBUTION OF THE POLES OF PLANETARY ORBITS.—Prof. H. C. Plummer recently found that the mean pole of the orbits of the minor planets was situated at a distance of 53′ from the pole of the ecliptic, in longitude 16·7°, and he was led to investigate its relation to the poles of the major planets (*Monthly Notices*, R.A.S., vol. lxxvi., p. 378). A diagram showing the relative positions of the poles revealed several features of interest, to which no special attention had previously been directed. It thus appeared: (1) that the poles lie three by three on five lines; (2) that the pole of each orbit, with the exception of Neptune, lies on two of these five lines; (3) that each line contains the orbital poles of two adjacent major planets. Prof. Plummer found it difficult to believe that this was merely a chance arrangement. Prof. J. B. Dale has since directed attention to further interesting features of the polar diagram (Roy. Ast. Soc., June). On measuring the inclinations of the five lines to the line drawn from the pole of the ecliptic in the direction 315°, he obtained the following results:—

(1) Earth—Mars—Mercury,	$3^\circ = 82^\circ - 79^\circ$.
(2) Earth—Uranus—Venus,	$31^\circ = 82^\circ - 51^\circ$.
(3) Uranus—Jupiter—Saturn,	$82^\circ = 82^\circ$.
(4) Mars—Jupiter—Neptune,	$136^\circ = 82^\circ + 54^\circ$.
(5) Mercury—Venus—Saturn,	$161^\circ = 82^\circ + 79^\circ$.

The directions of the five lines can thus be expressed very closely by the formulæ, α, $\alpha \pm 2\beta$, $\alpha \pm 3\beta$, where $\alpha = 82^\circ$ and $\beta = 26\frac{1}{2}^\circ$.

The diagram also shows that there are several pairs of lines joining poles which are nearly parallel. There is apparently nothing in the theory of the secular perturbations of the nodes and inclinations of the planetary orbits which would lead to the expectation of such definite relations, or to the continuance of these relations if they did exist at a given time, but Prof. Dale considers it almost incredible that they should be purely accidental. He inclines to the view that these remarkable relations may indicate the action of other forces, such as might be due to a resisting medium, in addition to the gravitational forces.

SOLAR VARIABILITY.—For the more precise study of the distribution of radiation of different wave-lengths across the sun's disc, the observing station of the Smithsonian Institution at Mount Wilson has been provided with a tower telescope having a concave mirror of 12-in. aperture and 75-ft. focal length. A description of this instrument, together with some of the observational results for 1913 and 1914, has been given by Messrs. Abbot, Fowle, and Aldrich (Smithsonian Miscell. Collections, vol. lxvi., No. 5). Spectrobolometric measurements were made at seven different wave-lengths, namely, 3737, 4265, 5062, 5955, 6702, 8580, and 10,080. The new results agree closely with those obtained at Washington in 1907, so far as the two series are comparable, and the curves of intensity distribution show in a very striking way the greater uniformity of the light across the disc as the wave-length increases. There were, however, slight, but significant, differences between the mean results for different years, a greater contrast of brightness between the centre and edge occurring in 1907 and 1914, as compared with 1913, taken as a standard; that is, in years when the solar constant was high the solar contrast was greater than usual. Besides the long-period change, there were small changes of contrast from day to day, correlated with short-period fluctuations of solar radiation; for this type of variation increase of solar radiation was attended by *decrease* in the contrast between the edge and centre of the disc. The authors are thus led to consider that there are two causes of change existing in the sun: (1) the increased effective solar temperature accompanying high solar activity, producing increased radiation and increased contrast; (2) the varying transparency of the outer solar envelopes from day to day, increased transparency resulting in increased radiation but decreased contrast.

MINERAL PRODUCTION OF CANADA.

THE preliminary report on the mineral production of Canada during the year 1915 has just been issued by the Canadian Department of Mines, and it is satisfactory to find that upon the whole the output shows a marked improvement upon the previous year. Amongst the metals the only decrease to be noted is in the production of silver, which amounted to 28,401,735 ounces, as against 28,449,821 ounces in 1914, so that the decrease is quite insignificant, and is less than the decrease in 1914 below 1913; it will be found that Canada contributes just about 13 per cent. of the world's total silver production. The gold output for 1915 was 916,076 ounces, as against 773,186 ounces in 1914; it may be noted that only about one-third of the gold production now comes from alluvial, and that although the production is less than it was when it was mainly derived from the easily-won alluvials of the Klondyke, the output is now increasing steadily. The copper output for 1915 is more than 102½ millions of pounds, constituting a record for Canada, and showing an increase of 35 per cent. as compared with the previous year.

Nickel is not being smelted in Canada on any scale worth mentioning, the bulk of the Canadian nickel production being exported to the United States and to Great Britain in the form of matte; the estimated quantity of nickel was 68 millions of pounds, again constituting a record, and being an increase of 50 per cent. on 1914. Seeing that Canada is the world's chief producer of nickel, it is a matter for regret that Canadian nickel refineries have not yet been established, and it is to be hoped that the Commission appointed last year to investigate this matter may find some effective means of rendering Canada independent in this respect.

The production of pig-iron in 1915 was 913,717 tons, an increase of 16⅔ per cent. above that of 1914, whilst the total steel output amounted to 1,020,335 tons, an increase of 23 per cent.; it is interesting to note that this item includes 5626 tons of steel produced in electric furnaces. Of the non-metallic products, by far the most important is coal, of which the output, 13,209,371 tons, shows a small decrease, namely, about 3 per cent., below that of the previous year. It may be added that the decrease in Portland cement and other structural materials, which was so marked a feature of the 1914 returns, has continued in 1915. Whilst all the above returns are stated as provisional, it is very rare that the final returns, when completed, differ in any important respects from those given in the preliminary reports.

NEW ASPECTS IN THE STUDY OF JUNGLE LIFE.

A VERY realistic description of the abundance and variety of animal life in the tropics is given by Mr. C. W. Beebe in *Zoologia*, vol. ii., published by the Zoological Society of New York. Mr. Beebe has had a wide experience of jungle-life in many lands, and hence his latest experiences in Brazil have the greater value, though his stay there was confined to a few days in the neighbourhood of Para. Abundance of species and a relative fewness of individuals, he remarks, are pronounced characteristics of any tropical fauna. This was abundantly confirmed during the trip now under discussion. He quickly discovered that more was to be obtained by watching particular trees which afforded special attractions in the form of vividly coloured fruit than in aimless wandering. From one such tree during the space of a week of intermittent watching he obtained no fewer than seventy-six species. His notes were not confined to birds.

Some of Mr. Beebe's most interesting observations are indeed those which relate to arachnids, insects, and the great land-snail, Strophocheilus, which was apparently eagerly sought by kites. His notes on *Acrosoma spinosa*, an exceedingly spiny, gaudy spider, the lurking place of which was in the centre of its web near the ground, will probably provide material for controversy as to the value of "warning coloration." "Its scarlet, yellow, and black coloration," he remarks, "seemed to indicate an unsavoury mouthful, and it was correspondingly slow to take alarm." But as it "hung upside down the brilliant colours of the upper side of the body [were] . . . completely hidden. When the creature was alarmed it dropped to the ground. . . . The moment it touched land it slipped under a leaf. . . . When caught in the hand it at once turned upon its back and feigned death." Thus no use whatever seems to be made of the "warning coloration"; on the contrary, the utmost care seems to be taken to conceal these tokens of inedibility. A "protectively coloured" species, *Epeira audax*, lived much more closely up to its traditional behaviour. When alarmed it would leave its web and seek safety by clinging to "mossy or lichened bark," with which its coloration harmonised so completely that "the eye had to search carefully to rediscover it each time it sprinted to safety."

Just before leaving a brilliant idea struck Mr. Beebe, and one which it is to be hoped will henceforth be followed, wherever possible, by all who visit the forests of the tropics. Filled with regret at leaving the scene of so many wonders, he suddenly bethought him to fill a bag with four square feet of jungle earth, and this was examined minutely with a lens while on board ship on the voyage home. For days and days the search went on, the captures being sorted out and placed in spirit. An amazing wealth of life was thus obtained, remarkable for its variety of form and coloration. The latter aspect again raises interesting problems concerning the precise significance of coloration. Among the captures thus made were representatives of two genera of ants new to science. There can be no doubt that important discoveries in regard to the animal life of jungle earth would accrue if this example of Mr. Beebe's were generally followed in the future. W. P. P.

EYESIGHT AND THE WAR.[1]

(1) *The Army Sight Test.*

AS the subject of refraction is our text this evening it is only meet that we should remember the enormous debt we owe to Donders, the great Dutch ophthalmologist, the centenary of whose birth will be celebrated in Holland as soon as the war is over.

One of the subjects that Donders threw light upon was myopia, or short-sight. In his classical work on refraction, published in 1864, he showed that the myopic eye was the over-developed eye, the too long eye, contrasted with the under-developed, the hypermetropic, or too short, eye.

Now myopia has been the *bête noire* of the War Office for very many years—thousands of young men, otherwise eligible, have been rejected for the Army because of myopia. The myope is useless without his

[1] Abstract of a Friday evening discourse at the Royal Institution delivered on June 9, by Dr. Ernest Clarke.

glasses, and the War Office has, up to the present, set its face against the wearing of glasses. The reasons which existed formerly, although, of course, quite inadequate now, were that we had a very small Army, and a sufficiency of officers and men could always be counted on, besides which, this small Army was mostly employed abroad, and then chiefly in the tropics, and lost or broken spectacles could not easily be replaced.

Not only must a myope wear glasses for distance, but he must wear them for near work—that is, *always*. It was the old treatment of wearing them for distance *only* (because he could see so well without them for near work) that we now know was the cause of the increase of the myopia, an increase which sometimes led to complete blindness.

When a myope does any near work without glasses he converges unduly; this means excessive pull on the internal recti muscles, which in their turn pull on the tunics of the eye, which leads to the eyes lengthening antero-posteriorly, which means that the eye becomes more short-sighted. This increase of myopia again causes more convergence, and so a vicious circle is produced.

(Lantern slides were here exhibited showing the harmful changes produced in high myopia, viz. atrophy of the choroid and retina, hæmorrhages at the macula, and retinal detachment.)

If the eyes are thoroughly tested under atropine or homatropine and the full correction given to be *worn always* they are thus made normal, undue convergence ceases, as the work can be held further from the eyes, and the ciliary muscle is made to work normally, and the progress of the myopia is stayed. Out of 532 myopes watched by me over a period of five years, all of whom were fully corrected, only *four* progressed to any appreciable extent.

In the Army we can get rid of the difficulty of replacing lost or broken glasses by having an oculist and one or more working opticians attached to every "centre" with a register of the glasses worn in that centre, and once we have this as part of the Army equipment we can replace an effete sight test, which judges only the uncorrected vision, by the Continental plan of estimating the value of a man's vision when corrected.

By the accompanying table we see that the highest amount of myopia we allow is about 2·5 D., whereas abroad 6 or 7 D. pass easily.

A strong argument showing the inadequacy of our present system is that men will pass in easily who, from the visual point of view, may be far worse than those rejected. A high hypermetrope, for instance, at twenty, will pass the present test easily, but some years later he has to use up the whole of his accommodative power in correcting his distant vision, and later still he even loses the power of correcting this, and so he must have glasses for distant and near vision, whereas the myope of 5 or 6 D., or more, will be able to read without glasses when he is a hundred years old!

It is true that at present a portion of the scheme suggested above is being adopted, but we want to see it in its entirety and for all time, and that in future the wearing of glasses will never be considered a disability in the Army.

Although myopia is the chief visual cause that keeps men out of the Army, high hypermetropia and astigmatism also do so, and the majority of cases can be made absolutely normal with suitable glasses.

(2) *Eyestrain.*

We now pass to the important subject of *eyestrain* as it affects our soldiers.

There are three chief causes of eyestrain:—(1) Low errors of astigmatism; (2) low anisometropia; (3) small want of balance in the external muscles of the eye.

(1) *Astigmatism.*—Large errors take care of themselves. The craving for distinct vision leads the possessor to have the error properly corrected, but he is generally totally unconscious of the presence of a small error, as the ciliary muscle, by producing an astigmatism of the lens—the inverse of that of the cornea—corrects it, with the result that his vision is so perfect that he is quite annoyed with the physician he is consulting for some functional nerve trouble, if he suggests that the eyes are at fault. It should be remembered that there is not a single *functional* nerve trouble that may not be caused by eyestrain. The great prevalence of astigmatism is shown in the

Table showing the Visual Standards for Recruits in the Chief European Armies.
(Paterson and Traquair.)

—	Amount of short-sight (myopia) allowed.		Standard of corrected vision.		Remarks.
	Combatants.	Non-combatants.	Combatants.	Non-combatants.	
GERMANY	6·5 D. For Landsturm no limit if standard of corrected vision attained.	—	1/2 in better eye. Other eye may have minimal vision. For Landsturm vision = 1/4. If one eye has vision = 1/2 the other may be blind.	—	Vision with glasses (corrected vision) counts.
AUSTRIA . .	6 D.	Above 6 D. no limit if standard of corrected vision is attained.	Group 1, 1/2 in each eye. Group 2, 1/2 in one; 1/4 in other.	1/4 in one; 1/10 in the other.	Vision with glasses counts.
FRANCE .	7 D.	Above 7 D. no limit if standard of corrected vision is attained.	1/2 in one eye; 1/20 in the other.	1/4 in one eye; 1/20 in the other.	Vision with glasses counts.
ITALY . .	7 D.	—	1/3 in each eye, or 1/12 in one eye if the other has 1/1 (full vision).		Vision with glasses counts.
GREAT BRITAIN	No amount specified, but according to vision required highest amount possible is about 2·5 D.	No amount specified, but according to vision required highest amount possible is about 2·5 D. in better eye and 3·5 D. in worse eye.	No correction allowed for general service. Uncorrected vision must be 1/4 in each eye, or 1/4 in the right eye with 1/10 in the left.	Uncorrected vision must be 1/4 in better eye, 1/10 in worse eye. The better eye may be the left.	Vision without glasses counts. For home service, garrison service, and garrison service abroad glasses are allowed within unspecified limits.

accompanying table, where, out of 5000 eyes, 4303 were found by me to be astigmatic:—

2500 individuals whose sight after correction was normal and who had no disease of the eyes.	1. Same refraction in both eyes. (657)	*a* Emmetropia (see Presbyopia below) ...	9
		b Hypermetropia ...	63
		c Myopia	22
		d Astigmatism — Hypermetropic	438
		Myopic ...	113
		Mixed ...	12
	2. Refraction different in the two eyes (Anisometropia)		1843
			2500
5000 eyes (as above)		Emmetropia	56
		Hypermetropia	425
		Myopia	216
		Astigmatism	4303
			5000

Of the 2500 individuals 961 were presbyopic, and only 9 of these were emmetropic.

(2) *Low Anisometropia.*—When the difference between the two eyes is small, impulses can pass from the brain to one ciliary muscle to correct this defect. In the above table, out of 2500 individuals, no fewer than 1843 had "odd" vision.

(3) *Want of Balance between the External Muscles.*—When small in amount impulses can pass to one muscle to preserve the balance and so avoid diplopia.

In all these instances of eyestrain this extra work means an enormous unnecessary waste of nerve energy going on all the waking hours, and it becomes imperative to stop this waste in all cases where a large amount of nerve energy has already been lost, which occurs from the effects of *high explosives* on our soldiers.

At the time of the explosion the "wind pressure" is so great that I have recorded a case[2] where, without being hit by any foreign body, an eye was completely destroyed through detachment of the retina by wind pressure. This wind pressure is followed by a high vacuum, which may be so great that in one case I saw at the King George Hospital the eye had been evulsed. Such effects show how the soldier's nervous system can suffer. Nerve energy is lost—as after a bad railway collision—"virtue" is knocked out, and it becomes imperative to conserve all the energy that is left, and we must therefore remove the eyestrain if it is present. At the King George Hospital our resident ophthalmic medical officer, Dr. Harwood, is keenly alive to the ill-effects of eyestrain, and almost miraculous have been some of the cures by simply putting the invalid into glasses. The neurasthenia following head injuries can often be cured in the same way, and we had one very marked case as an example of this. The man, aged thirty-eight, was hit on the head while lying in his dug-out at Gallipoli by a wet sand-bag falling 8 ft. He was not rendered unconscious, but could not stand or walk. After about six weeks he was admitted into the King George Hospital. His symptoms all the time had been inability to stand or walk, constant headache and giddiness, inability to read or even look at the light, with rather sluggish memory and mental faculties—no treatment had succeeded. Dr. Harwood put the eyes under atropine, when there was an immediate improvement. He was given glasses correcting 0·25 astigmatism in one eye and 0·37 in the other. Within a few hours of getting the glasses he was reading, and within a week he could stand and walk, and his headache and giddiness had disappeared.

[2] *Medical Press and Circular*, December 29, 1915.

In many cases where wounds had remained sluggish, the nerve energy required for the healing processes being used up by eyestrain, a suitable pair of glasses immediately proved a remedy.

When there is a want of muscle equilibrium the correction of the astigmatism generally removes it, and in bad cases of head injuries, when testing the patient was impossible, Dr. Harwood has obtained excellent results by simply bandaging up one eye. The testing has to be very carefully done, always under a cycloplegic, and the ophthalmometer is a most invaluable instrument for estimating the astigmatism, even 0·12 D. being recorded.

(The ophthalmometer and its working were here explained.)

(3) *Presbyopia.*

We have been reviewing the effects of the war on combatants; we now turn to the effects produced on those of us who are disqualified by age to take an active part.

We have been considering defects of the eyes due

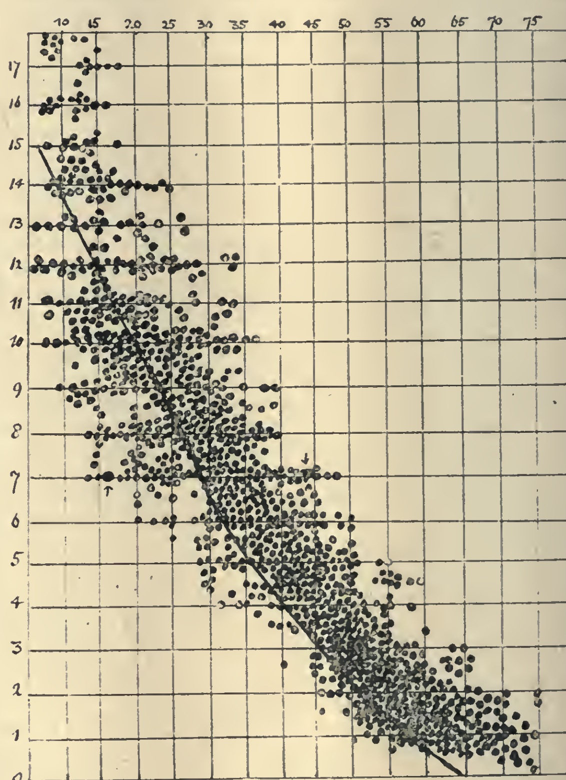

FIG. 1.—Variation of accommodative power with age. 1200 cases.

to their shape, and have seen how prevalent these defects are; yet some eyes (it is true very few) are normal. Now there is a defect that attacks *all* eyes if the individual lives long enough, viz. presbyopia, or old sight. It may not be manifest, and the individual may be quite unconscious of it, but nevertheless no eye, after about the age of forty-five, escapes it. It is a senile change, and is, as Donders observed, no more a disease than is grey hair.

At the beginning of life the crystalline lens is nothing more than a little bag of semi-fluid jelly. By making the lens thicker we can focus for near objects. This is done by the ciliary muscle, and chiefly by that portion of the muscle which surrounds the lens and acts like a sphincter. Tscherning's theory of the accommodation which states that the lens is squeezed

by the circular portion of the ciliary muscle and made to bulge in the centre explains all the clinical phenomena, which the old theory (Helmholt's) failed to do. The aberration which the central bulging would cause at the margin of the lens is masked by the contraction of the pupil, which always accompanies normal accommodation; thus the accommodative power depends rather on the "squeezability" of the lens than the power of the muscle. Now this "squeezability" of the lens becomes less as the lens tissue becomes firmer. I have known in a young child the accommodative power to be as much as 20 D., whereas it is rare to find anyone above forty-five with an accommodative power higher than 4 or 5 D. Donders gave us a diagram showing the gradual loss of accommodative power through age, *i.e.* through the sclerosing of the lens, but he only examined 150 cases, and included in these some latent hypermetropes, so that he reckoned the accommodative power per age lower than it really is.

The diagram (Fig. 1) was prepared by me from 1200 cases, all of which were first made normal by correcting their defects. Donders's *mean* line is marked, and it is seen that it coincides practically with my minimum line from the age of thirty. From my table the presbyopic point may be said to be arrived at between ages forty-five and forty-eight; in other words, the emmetrope, or those made emmetropic by correction, must at that age have increased help for near work.

Age	Minimum	Mean	Maximum
7–10	9	14	18
10–15	7	12	18
20	6	10	14
25	5·5	9	13·5
30	4 5	7·5	12
35	4	6·5	10
40	2 5	5·5	8·5
45	2	4	7
50	1	3	0
55	0 75	2	5
60	0·50	1·75	4
65	0·50	1·5	3
70	0·00	1	2

In the above table made from my diagrams there is seen to be a great difference between the maximum and minimum. What is the cause of this difference? If a person has more accommodative power than the average it means that he is younger than his years, and if less, older.

Among the many causes of premature senility, which a lessened accommodative power implies, the following are the chief:—

(1) *Alimentary Toxaemia.*—As amply shown by Sir William Arbuthnot Lane. In these cases I have found the lens to be a very delicate index.

(2) *Eyestrain.*

(3) *Worry, Anxiety, Sorrow, and Overwork.*—This war has hastened the onset of presbyopia, and increased it rapidly in those already presbyopic, throughout England, and probably throughout Europe. The only preventive treatment is peace, but until that comes we should conserve all the nervous energy we have and not waste it.

Intestinal toxæmia should be removed by the surgeon or physician. Eyestrain should be prevented; if there is any defect besides the presbyopia (and it must be remembered that simple presbyopia is very uncommon, only about 1 per cent. of presbyopes) it must be corrected, and the invisible bifocal glasses, which correct the distant vision in the upper portion and the reading in the lower, give the best result. If two separate glasses are worn they are not changed when they should be. The presbyopic period is just that time of life when it is most important to conserve all possible nerve energy. Responsibilities, worries, and anxieties are probably at their maximum, and we have not yet reached the callousness of old age!

Finally, for our own sakes and also for those around us, we should not make the most of our troubles; we should not go out to meet them, nor let "to-day's strength bear to-morrow's loads."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Board of Education has issued a circular (961) stating that with a few alterations the Regulations for Technical Schools, etc., in England and Wales (Cd. 7996) will continue in force for the school year 1916–17. The special regulations for grants in aid of instruction for men serving with the colours are withdrawn, as it appears from the returns of the work done during the past winter that there is now little demand in camp for classes of an educational character.

THE Weardale Lead Company is establishing two mining scholarships, each of the annual value of 60*l.*, in connection respectively with the Royal School of Mines and Armstrong College, Newcastle-upon-Tyne, with the object of combining university training with a year's practical work calculated to advance a student in the knowledge of mining engineering. The scholarships are to be known as the "Richardson" and the "Cameron," after two directors of the company.

THE first award of the annual prize of 40*l.* founded by the Earl of Cromer, and administered by the British Academy, for the best essay on any subject connected with the language, history, art, literature, or philosophy of ancient Greece, will be made before the end of 1917. The competition is open to all British subjects under the age of twenty-six years on October 1, 1917. Intending competitors must send the title of their proposed essay to the Secretary of the British Academy, Burlington House, Piccadilly, on or before December 1, 1916. The essays on approved subjects must reach the Academy by, at latest, October 1, 1917.

THE current issue of the *Reading University College Review* is concerned almost exclusively with the affairs of the college. It includes the sixth revised list of present members of the staff, past and present students, and present servants of the college who are serving with the Forces or in the French Army. The numerous notes which begin the review serve as an excellent record of the various developments in the activities of the college. Among these, the extension of domestic training may be mentioned. A scheme has been sanctioned for a diploma course in domestic subjects extending over two years, and for a certificate course extending over one year. The aim of these courses is to train girls of good secondary education to manage an institution, household, or home with practical efficiency and intelligence. Instruction in poultry-keeping has been inaugurated, and the work of the department of horticulture is being extended.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 14.—M. Paul Appell in the chair.—C. **Richet**: The conditions which influence the average monthly deviation of the birth-rate. In countries with a high birth-rate (more than 350 per 10,000) the mean monthly deviation of the birth-rate

is more than double that of countries with low birth-rate.—E. **Esclangon**: The sound of gunfire and zones of silence. The detonations arising from the sudden expansion of gas at the mouth of the gun and from the explosion of the shell, even of the largest calibre, are inaudible at about 30 kilometres, and the author concludes that the sounds heard at distances of 50 to 200 kilometres from the front are due to the waves set up in the air by projectiles moving with initial velocities greater than the velocity of sound.—L. **Bouchet**: The electric expansion of solid insulators in the sense normal to an electrostatic field. The changes of length were observed by an interferential method for glass, ebonite, and paraffin. Calculations based on Maxwell's equation for the pressures normal to the field agree well with the experimental figures for paraffin wax, but are not in accord with the results for ebonite and glass.—R. **Ledoux-Lebard** and A. **Dauvillier**: Theoretical and experimental researches on the bases of radiological dosimetry.—Ed. **Lesné** and M. **Phocas**: The presence of living and virulent micro-organisms at the surface of projectiles enclosed in cicatrised tissues. Experiments with bullets extracted from healed wounds demonstrate the reality of latent microbism.

NEW SOUTH WALES.

Linnean Society, May 31.—Mr. A. G. Hamilton, president, in the chair.—T. G. **Sloane**: Carabidæ from the Upper Williams River, N.S.W. In December, 1915, a party of naturalists, organised by Mr. W. J. Enright, of West Maitland, visited the part of the Mount Royal Range known as the Barrington Tops —a basalt-capped plateau, 5000 ft. above sea-level, from which the Barrington, Allyn, Paterson, and other rivers take their rise. The route followed was north-west from Dungog, along the Williams River; after the level of 3500 ft. is reached, the track keeps to the summit of the narrow ridge dividing the valleys of the Williams and Allyn Rivers, until, beyond the source of the Williams, Barrington Tops are reached, distant about 37 miles from Dungog. *Fagus moorei* is the predominant tree in the brushes at 4100 ft. and upwards. In one locality, near the southern source of the Barrington, at about 4800 ft., *Eucalyptus coriacea* was plentiful. Collecting was carried on in six localities, four of them above 4000 ft., and two much below. Representatives of forty-six species of Carabidæ were obtained, and have been identified, of which nine, and two varieties, are described as new. Eighteen species, all of which are known from the coastal districts between Sydney and the Clarence River, were found to occur below the level of 4000 ft. Specimens of twenty-eight species were collected above this level, mostly members of typical eastern Australian genera. The most striking is a remarkable species, doubtfully referred to Trichosternus, which appears to be more closely allied to certain New Zealand species than to any known Australian species. Another notable species is *Agonochila ruficollis*, Sl., hitherto known only from the forests of south-western Australia; but this is closely allied to a Tasmanian species, and to *A. binotata*, White, from New Zealand. —H. J. **Carter**: Description of a new genus and three new species of Tenebrionidæ from Barrington Tops, N.S.W. A genus, with the facies of Cryptodus, and presenting some resemblance to Asphalus, Pasc., with one species, and two species of Cardiothorax, are described as new.—The late Dr. A. **Rutherford**, with notes by E. **Jarvis**: A new scale-insect affecting sugar-cane in New Guinea. A new species of Aulacaspis, different from either of the two known Australian species, is described.

BOOKS RECEIVED.

Highways and Byways in Galloway and Carrick. By the Rev. C. H. Dick. Pp. xxix+536. (London: Macmillan and Co., Ltd.) 6*s*. net.

Bacon's Large-Scale Map of the British Battle Front. (London: G. W. Bacon and Co., Ltd.) 6*d*. net.

Smithsonian Institution Bureau of American Ethnology. Bulletin 62. Physical Anthropology of the Lenape or Delawares, and of the Eastern Indians in General. By A. Hrdlička. Pp. 130. (Washington: Smithsonian Institution.)

Domestic Science. By C. W. Hale. Part ii. Pp. x+300. (Cambridge: At the University Press.) 4*s*. net.

Field and Laboratory Studies of Crops. By Prof. A. G. McCall. Pp. viii+133. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 3*s*. 6*d*. net.

American Civil Engineers' Pocket Book. By M. Merriman and others. Third edition. Pp. ix+1571. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s*. net.

Parks and Park Engineering. By Prof. W. T. Lyle. Pp. viii+130. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

Earth Pressure, Retaining Walls, and Bins. By Prof. W. Cain. Pp. x+287. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

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